DOCUMENT RESUME

ED 246 694 FL 014 512

AUTHOR	Wyatt, David H.
TITLE	Computers and ESL. Language in Education: Theory and Practice, No. 56.
INSTITUTION	ERIC Clearinghouse on Languages and Linguistics, Washington, D.C.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC.
REPORT NO	ISBN-0-15-599297-X
PUB DATE	84
CONTRACT	400-82-0009
NOTE	129p.
AVAILABLE FROM	Harcourt Brace Jovanovich International, Orlando, FL 32887
PUB TYPE	Information Analyses - ERIC Information Analysis Products (071)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	Attitudes; *Computer Assisted Instruction; *Computer Managed Instruction; Computer Oriented Programs; *Computers; *Computer Software; *English (Second Language); Futures (of Society); Grammar; Information Sources; Listening Skills; Literature Reviews; Program Implementation; Publishing Industry; Reading Instruction; Recordkeeping; Research Tools; *Second Language Instruction; Speech Skills; Vocabulary Development; Writing Instruction

ABSTRACT

The state of the art of computer-assisted language learning (CALL) in instruction of English as a second language (ESL) is examined. An overview of computer applications in the field discusses computer roles in language learning, computers and the standard curriculum, computer requirements for different types of CALL (instructional, collaborative, and facilitative), the promise of CALL in the ESL curriculum, and the benefits offered by computer-assisted learning. An analysis of computer-assisted learning in specific areas of ESL looks at: reading and vocabulary; writing and vocabulary; listening; speaking; grammar; and other areas such as study skills, cultural orientation and education, testing, English for special purposes, bilingual ESL, and potential applications of the computer as a teacher's aide (in word processing, linguistic research, with supplementary materials, and as an electronic gradebook). A section on directions, resources, and considerations for development in CALL focuses on obstacles in the development of software, such as student reaction, areas of criticism of existing programs, system compatibility, technological advancement, hardware requirements and attitudes, and lack of communication among CALL users. A list of sources of software and CALL information, including addresses, and a bibliography are appended. (MSE)

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ED246694

COMPUTERS AND ESL

by David H. Wyatt

A Publication of Center for Applied Linguistics

Prepared by ERIC Clearinghouse on Languages and Linguistics

FL014512

LANGUAGE IN EDUCATION: Theory and Practice No. 56

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Permissions, Harcourt Brace Jovanovich, Publishers
Orlando, FL 32887

Printed in the United States

ISBN 0-15-599297-X

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Section A: Overview of Computer-Assisted Language Learning

A PLACE FOR THE COMPUTER

In any field of education there are periods of calm and stability, when our course appears clear and settled, punctuated by bursts of intense activity and new development, during which the very earth seems to be shifting beneath our feet. Over the last three years, one such development has been gathering momentum: the arrival of the computer in our classrooms. As early as 1981, *Newsweek* pointed out that

> there are more than 50,000 computers in use in the country's schools, and the number is multiplying rapidly. 'The schools may be broke, but I'll be darned: they're buying microcomputers.'

Not to be outdone, *Time* nominated the computer as its Man of the Year for 1982. At a conservative estimate, the total number of microcomputers and terminals had reached 300,000 by the summer of 1983, an average of close to four computers per public school.

In the past, the cost of computer equipment greatly restricted the use of computers in education. Now, however, computers are becoming increasingly affordable and available in our institutions. Indeed, in some cases considerable pressure is being put on educators to make use of the new technological marvels in their courses. In these circumstances, answers are needed to a number of crucial questions. Do computers have any role to play in English language learning? If so, how can they best be used? What types of software do we need, and for which aspects of the curriculum? Concerns such as these will be the principal focus of this book.

One of these questions can be answered immediately--computers indisputably can make a worthwhile contribution to the teaching of English as a second language. It is possible to make this assertion despite the healthy skepticism and sometimes accurate criticism that have greeted some aspects of CAI (computer-assisted instruction). When the more valid critiques are carefully analyzed, it becomes apparent that they do not apply to one of the three main roles the computer can play: that of *facilitator*. This point will be explained in more detail in the following section. However, it is hardly surprising that the involvement of computers in language learning has been perceived as being one-dimensional up to now. The term 'computer-assisted instruction' itself is suggestive of only one role for the computer, exemplified in drill-and-practice and tutorial materials. For this reason, it was generally agreed at the CAI symposium prior to the 1983 TESOL (Teachers of English to Speakers of Other Languages) Conference to adopt the alternative designation CALL: computer-assisted language *learning*. Throughout this book, therefore, the term CALL will be used to emphasize the whole range of possible roles that the computer can play.

Before leaving the subject of terminology, three other standard expressions should be explained. *Hardware* refers to physical equipment such as computers, video monitors, disk drives, and diskettes (these will themselves be explained in the chapter on hardware). By contrast, *software* refers to the computer programs (lists of instructions that direct the computer's actions) and data that are stored on diskettes and tapes or in the computer in magnetic or other forms. One type of software is educational programs, which are known as *courseware*. Throughout this book the term 'computer' will be used to refer to both microcomputers and larger computer systems with terminals unless specifically stated otherwise.

Later we will be examining in great detail the potential of CALL for the main skill areas and aspects of English as a second language. Before moving computer-assisted techniques to the center of the stage, however, it is important to develop an understanding of their place--their *limited* place--in the overall learning process. In the last decade, the field of ESL has seen the emergence of a number of new approaches and methods for which overstated claims have sometimes been made. Certain proponents of new approaches have appeared to aim at entirely replacing former methods with the new. It is essential to realize that this type of claim is not being made for computer-assisted language learning. As the term itself implies, the emphasis is on using the computer to *assist* the learning process. The objective of CALL is to enhance teachers' ability to teach, not to replace them.

It should become apparent that computer-assisted learning is not tied to any single learning philosophy. An unfortunate and widely held misconception is that CALL is intrinsically behaviorist in nature. Although some program developers have certainly confined themselves to behavioristic materials, it is equally possible to adopt either cognitive or acquisition-based approaches in developing courseware. Similarly, activities may focus anywhere on the spectrum from mechanical through meaningful to communicative material. While some authorities in the field of language learning obviously hold strong opinions in favor of certain types of approaches and activities, it is probably true to say that most courses and teachers make use of an eclectic blend of all the above approaches and activities where experience has shown them to be effective. Computer-assisted materials can potentially be designed to reflect any of these techniques.

As the focus turns to the computer in later sections, it is important to bear in mind the relatively restricted role of CALL in the overall language-learning process. Within these limits, however, computers represent a most exciting development in educational technology. One of their strongest points is their flexibility. In the past, technological devices tended to perform only one function or a few similar functions. Today, the functions of a language lab station, a tachistoscope, and a word processor can all be provided by the same computer.

Surprisingly, when working with properly designed ready-to-use courseware, the computer can be one of the easiest educational technologies to use. Teachers do not need to know anything about programming or the inner workings of a computer, just as they can use the language laboratory without needing to understand the electronic circuits in the lab's tape recorders. However, they do need to be thoroughly familiar with the content and operation of the courseware, just as they must be able to thread a tape, know how to control student consoles, and be familiar with the recorded material in a language laboratory. The need for basic-level teacher training and familiarization of this sort in preparation for using computer-assisted materials is considerable, and the importance of this vital factor is often seriously underestimated.

COMPUTER ROLES IN LANGUAGE LEARNING

The computer has the potential to play a large number of different roles in ESL. These have been characterized in a number of ways (Kemmis et al. 1977; Higgins and Johns 1984). However, they will be grouped into three main categories for the purpose of this discussion: the roles of *instructor*, *collaborator*, and *facilitator*.

Historically, computer-assisted instruction has been closely identified with the *instruction* role. The two predominant types of activity associated with this role are drill-and-practice exercises and tutorial programs (Frederick 1980). In the former, students are assumed to have already received an introduction to the topic, and the drill is designed to provide carefully structured opportunities to use and master the relevant points.

Tutorial CALL is more ambitious in that it also takes on the burden of introducing the topic to students, assuming little or no prior introduction. Topics are typically broken down into small learning steps with questions following each one to determine whether the point has been understood. There are often elaborate branching possibilities to provide extra instruction and practice for students who experience difficulty in grasping the material. Both drill-and-practice and tutorial programs generally have associated management systems that can provide extensive score and progress reports to students and their teachers. In this and other ways, such programs are clearly planned on the assumption that only one student will be working at each microcomputer or terminal.

In the instructional role, the computer program presents material and conducts practice activities as an authority figure. It teaches students in a highly preplanned fashion, and they have only to follow the directions and work at producing the anticipated language forms and responses. Students are actively involved in the learning process, but their role is that of responder rather than initiator. This closely mirrors some of the activities that are found in our workbooks, textbooks, and classrooms.

The second main role for the computer, *collaborative* CALL, has received much less attention to date. The distinguishing characteristic of this approach is that the initiative is turned over to the student or group of students. Sometimes the end result of the activity will be predetermined, and sometimes it will be completely unpredictable. More important, the path to the final goal and the language used by students *en route* will vary quite widely since they will depend on the students' individual decisions. This can be achieved in some cases in very simple ways. For example, when working with question patterns, one type of activity might involve the students' trying to discover some items of information that the computer alone possesses. The only way for students to obtain the information is by questioning the computer, which acts as an interlocutor, yielding information only when the appropriate questions are addressed to it. As a second example of the computer as collaborator, it might provide a group of students with a simulation such as a trip along a pioneer trail to the Old West. Again, students are themselves responsible for initiating and directing the activities that occur in the learning environment.

Some collaborative activities are conceptually related to traditional class methods. Conceivably, certain activities (such as simulations) could actually be conducted in the classroom without computer equipment, although frequently they would be more difficult to stage in this way and less attractive to work with. Quite a number of them, however, represent entirely new ideas that could not be realized without the computer.

The third main category consists of *facilitative* applications of the computer. Here, the computer simply serves as a tool (Coburn et al. 1982) in other language-learning activities; in itself, it is essentially empty of instructional content. It should be emphasized that the 'other activities' referred to are not necessarily computer-assisted activities at all. For example, a writing class can be taught in an entirely traditional manner except that some or all of the writing assignments are to be done using the computer as a word processor. Through its ability to store each draft of an assignment and provide easy editing techniques, the computer can greatly facilitate the writing process. None of the actual teaching need be done on the computer. Similarly, a potential role for the computer in reading classes is that of electronic dictionary (Jamieson and Chapelle 1982). It might be objected that such roles are not examples of computer-assisted learning *per se*. However, their potential contribution to ESL courses and their relative neglect in the past argue for their admission into the ranks of CALL.

One important role of the computer is as teacher's and researcher's aide. As frequent users of the typewriter, teachers will discover that the word-processing capabilities of the computer, once experienced, will soon become indispensable. The fringe benefits of storing all formerly typed material as computer 'documents' are equally impressive. For instance, through optional extra programs, one can usually run automatic spelling checks and generate readability indexes on any of the stored 'documents.'

An entirely different application involves the use of a telephone connector known as a *modem* to enable the computer user to communicate with the ever-growing number of databases such as the ERIC (Educational Resources Information Center) system. In this way, researchers can gain immediate access to powerful sources of information. Since they do not relate directly to student activities, these topics have not been designated as a fourth category of CALL. They will be described in more detail in Chapter 9.

CALL AND THE STANDARD CURRICULUM

In the light of the above distinctions, how closely do the different types of computer-assisted learning activities fit in with the standard curriculum? As far as instructional CALL is concerned, there is a relatively high degree of correspondence. Drill-and-practice activities are one of the main ingredients of the workbooks that accompany many ESL courses. Much of the material could be very easily computerized, providing the advantages described in later chapters.

It is interesting to note that this notion of using the computer as an 'electronic workbook' has been strongly attacked in some quarters. Some educators suggest that the computer should be reserved for activities that cannot be done without it. This may have some validity in the current situation in which relatively few computers are available and computer time is a scarce resource. Other than this economic justification, however, there seems little cause to restrict computer applications in this manner. One of the most attractive features of the computer is its versatility, and there appears to be no reason *a priori* why it should not be used both for these activities and as an electronic workbook. The teacher's decision on whether to implement one or both of these uses will probably depend on a host of practical factors, including the availability of computer time (see the next section) and the perceived importance of the different types of material.

The computer as workbook has also been attacked on much deeper philosophical grounds (drill-and-practice at times has been called 'drill-and-kill'). While it must be conceded that far too many unimaginative, uninspired, and pedagogically unsound drill-and-practice materials have been produced, this type of criticism has been widely misunderstood by its proponents and opponents alike. On closer examination, it is not directed at computers and computer-assisted learning at all; rather, it is a rejection of instruction itself, whatever the medium. On the premises of this argument, many widely used textbooks and virtually all workbooks would also be rejected along with instructional computer programs.

It is likely that some of these reactions are due to the 'spotlight effect' of educational applications of the computer. Many teachers who become involved in computer-assisted materials development soon recognize that this is a medium that reveals the methodological assumptions of its authors with unusual clarity. The effect is of great potential benefit to the profession, holding up a mirror in which we can more closely examine some of our teaching and learning practices.

Instructional CALL activities such as drill-and-practice and tutorials tend, therefore, to parallel closely some aspects of the conventional curriculum. They can focus on, present, and provide practice with many of the teaching points and objectives.

Collaborative CALL activities are much more difficult to characterize since they are so diverse. Generally, however, they have a much less precise focus. Frequently they deal with higher-level language use and most closely resemble the communication activities that are the culmination of a learning sequence in many class or textbook approaches. They tend to be integrative, involving a number of different linguistic elements rather than concentrating on a single aspect of language. In general, their 'fit' with the standard curriculum is much looser and less easy to specify.

By definition, facilitative activities fit into the standard curriculum in very obvious ways wherever they are appropriate. They simply function as tools to enable regular classroom activities to proceed more easily and efficiently.

COMPUTER REQUIREMENTS FOR DIFFERENT TYPES OF CALL

The advent of the computer in educational institutions has been a very uneven process so far. Some departments already have surprisingly extensive access to computers, while many others have none at all. Where computers are already installed, some institutions have chosen to group them into learning centers, sometimes as part of existing media centers or language laboratories. Other schools have decided to spread them out to provide one or two computers in every classroom. The number of computers available in a given location for use during class time is an important factor in considering what types of CALL are feasible.

A second important consideration in selecting CALL materials is the type of computer available. Recently, microcomputers (also known as 'home' or 'personal' computers) have begun to dominate the scene, although large mini- and mainframe computers are still being used for educational purposes. Even within the ranks of microcomputers, however, there are very significant differences. For example, the cheapest microcomputer systems use very slow cassette tape storage for their programs, whereas more expensive microcomputer systems use much faster diskette storage. (More information on computer hardware and systems will be given in the next chapter. Those readers who are unfamiliar with basic computer hardware may wish to review that information before continuing here.) For the moment, it is important to realize that different computer systems are not always equally suited to different categories of CALL.

Points such as these are significant factors in considering approaches to use with computers that have already been installed. They are even more important when decisions must be made about the purchase of new CALL hardware.

Instructional CALL

How do these factors influence the selection of different types of computer-assisted material? With instructional CALL, the courseware is originally designed for use on a one-to-one basis, with each student working at a separate computer station. It is obvious that this demands a relatively high level of computer availability. If all students are to be using the computers simultaneously during regular class time, then it is likely that most of the available computers will need to be grouped in learning centers. Even with a large number of computers in a school, instructional CALL materials could not be used in this way if the computers were spread thinly among the classrooms.

With a relatively small number of computers, however, instructional CALL materials can be put to other kinds of effective use. One method is to assign them as 'homework' to be completed in the learning center on the students' own time. This is feasible even with a small learning center, provided that it remains open for sufficient periods when students are free to use it. Alternatively, rather than using computer materials as an integral part of the curriculum, teachers can assign them to individual students as necessary for remedial or make-up work. The problem of insufficient computers for use during the regular class period can also be solved in at least two other ways. (1) The teacher can work with the rest of the class while individual students take turns working one-on-one at the available computers. (2) Students can work in pairs at the computer. The latter alternative represents a major change in orientation, however, since many of the advantages of instructional CALL are dependent on its use by students working alone. On the positive side, the interactions between the pairs of students often involve valuable language use.

In terms of the type of computer needed, instructional CALL materials generally require at least diskette-based microcomputers or mini- or mainframe systems. Microcomputer systems using cassette tape storage generally cannot maintain student score and progress records or move rapidly from program to program.

Collaborative CALL

This type of computer-assisted material can have very diverse requirements. Some collaborative exercises are designed for use by individual students working one-on-one with the computer, although often they are also quite suitable for pair or group work. On the other hand, certain collaborative materials cannot be used by fewer than two students. In some cases, these materials work successfully with up to five or six students at each computer. Clearly, much collaborative courseware can be used even in circumstances in which the availability of computers is very limited. If computer-assisted materials are to be used during class time, this type of CALL is obviously the most feasible for many institutions.

Collaborative courseware is also less demanding in terms of computing power. Even the most inexpensive cassette-based microcomputer systems can generally run many types of collaborative exercises.

Facilitative CALL

The use of facilitative programs during regular class periods requires a relatively high level of computer availability. The amount of computer power needed varies widely, depending on the particular application. With word-processing applications in the writing class, even cassette-based microcomputer systems are often capable of functioning as reasonably effective word processors. To provide a substantial electronic dictionary for the reading class, however, neither cassette- nor diskette-based systems would be adequate, and hard disk systems would be required. (These items of hardware are explained in more detail in the next chapter.)

THE PROMISE OF CALL IN THE ESL CURRICULUM

In the second section of this book, we will examine in detail the various possibilities for the different types of CALL activities as they relate to specific skills and aspects of the curriculum. This chapter has laid the groundwork for a closer understanding of the issues by distinguishing among three main types of computer-assisted learning material. Before bringing this introduction to a close, let us make a brief overall assessment of the potential contribution of each type of material.

Because of their close relationship with many aspects of the curriculum, textbooks, and classroom practice, instructional CALL materials can be integrated extensively with our courses. Their very familiarity may enhance their acceptability in the minds of many who are newcomers to computer-assisted learning. One of the chief arguments for this type of CALL is that it performs in a more efficient and individualized way the same types of activity that are implemented in the traditional classroom. These are limited but very worthwhile goals. Instructional courseware can thus be expected eventually to have a broad impact on the ESL curriculum. In the short term, it will have a more restricted effect because of the time needed to develop good courseware and the relatively high level of computer availability necessary for its use.

The potential impact of collaborative CALL is harder to assess. Because instructional materials can make such a broad contribution to the curriculum as a whole, it is conceivable that administrators might be persuaded to acquire the necessary computers to implement instructional courseware. The contribution of collaborative materials is much harder to predict and define. Correspondingly, it is more difficult to imagine an administrator's being convinced of the need to purchase computers for this type of material. Being much less strictly tied to specific aspects of the curriculum, many of the collaborative materials currently available have a 'supplementary' air. On the other hand, some collaborative courseware can be used in situations where few computers or only the less powerful cassette-based systems are available, so that these materials may represent a more practical alternative for some institutions just beginning to experiment with CALL.

Collaborative materials also have the potential to involve students in quite new activities that cannot be implemented in the traditional classroom. In general, these materials are similar to instructional materials in the time required for their development. However, quite a number of existing programs originally intended for entirely different purposes can be used without modification as collaborative courseware in ESL classes.

In terms of immediacy, however, the facilitative approach in the form of word processing has the potential for the greatest impact. There are literally hundreds of different types of word processors available for microcomputers, so that no development time is involved. The only drawback is the level of computer availability that is necessary. Other facilitative CALL programs may take longer to make an impact due to the much greater computing power required as well as design and development time.

BENEFITS OFFERED BY COMPUTER-ASSISTED LEARNING

The benefits that computerized materials can bring to the learning process depend to a considerable extent on the particular category of CALL in question. However, one important advantage of computers over many earlier types of educational technology is common to all CALL materials: their interactivity. One of the very real drawbacks of the language laboratory is that the sequence of items on a given tape is entirely fixed. Because of its nature as a linear medium, standard tape equipment cannot respond in any way to the student's answers, whether these are right or wrong. In contrast, even simple computerized materials can be highly interactive in the sense that the computer program responds differently and appropriately to the 'best' answer, alternative correct answers, predicted wrong answers, and other wrong answers. Immediate and informative feedback can thus be provided, and students are generally kept continuously aware of the results of their use of language.

Instructional CALL has a wide spectrum of other beneficial features to offer to the learning process. Well-designed programs are highly student centered. One facet of this is self-pacing: students are generally given complete control over the speed of presentation of material. If they wish, students can usually choose to work repeatedly on topics that are interesting or difficult for them. The computer will provide patient, tireless practice for as long as necessary. In this context, the emotionally neutral tone and absence of a peer group audience permit students to take risks, make mistakes, and try again to a much greater extent than they might be willing to do in the 'public' classroom.

Students are also continuously active and involved in CALL materials, since each student is individually answering all the questions, and the program will not continue until the student takes the necessary action at every step. This again contrasts with other technology, such as the language laboratory, in which the taped material will continue to roll along regardless of even complete inactivity on the part of the student. (It should be understood that these remarks are not intended as an indictment of the language laboratory. On the contrary; it has a valuable role to play in language learning. However, it is important to recognize the strengths and limitations of both computer and language lab technology.)

Instructional programs also have the capacity for a high degree of individualization. As only one student is assumed to be using the material, it can be designed to adapt to individual strengths and weaknesses. Students experiencing problems may be given messages pinpointing the difficulty, followed by repeated opportunities to try again. To deal with serious problems, individual students may be branched to more elementary tutorials and simpler exercises before rejoining the original activity. In the meantime, abler students may be moving rapidly through the instructional sequence, being allowed to finish exercises early whenever they demonstrate a clear mastery of the topic. Further, drill material can be presented much more rapidly on the screen than through the workbook, with attention focused on salient points only. Instructional CALL can also provide extensive class administration and management options. Detailed records of student usage, scores, and performance can be maintained for the information of both teachers and students. Diagnostic and achievement tests can be administered by computer with automatic routing to the necessary CALL materials for future developmental work or remediation. Course grades and statistics can be computed and printed out to the teacher's specifications.

It is important to be aware that the pedagogical effectiveness of instructional CALL materials has been demonstrated convincingly in the areas of mathematics and language arts as well as in other fields (Ragosta et al. 1982). Quantitative studies on learning gains in English as a second language are much more difficult to locate. However, qualitative studies have been reported that fit in with the intuitive evidence of ESL teachers who have used instructional CALL materials with very positive results in terms of student acceptance and satisfaction. We will return to this topic in the final section of the book.

Collaborative CALL programs as a whole do not have many of the features of instructional CALL materials. For example, collaborative programs for use by groups of students often lack much of the potential for true individualization and self-pacing, with the common denominator now being the group rather than the individual. Similarly, the administrative and management features are either much reduced or entirely absent. In compensation, the computer-as-collaborator offers some significant new benefits. Chief among these is the sharp change in the role of students, who assume much greater responsibility for their learning. Instead of acting essentially as responders to problems set by the computer, students now initiate much of the activity themselves, whether with the computer, with other students, or both. The aim is for students to 'work' or 'play' with the computer--it is difficult to know which term is more appropriate--and to acquire and use language in the process.

Collaborative materials make use of the computer in a large range of roles, many of which are new and difficult to emulate without the computer environment. They appear to offer very worthwhile learning experiences. Teachers who have worked with such programs in the ESL classroom are enthusiastic about the types of language use that the software can stimulate. This type of CALL is relatively new, however, and there appears to be no quantitative or qualitative research published so far on its effectiveness. Unfortunately, the very nature of collaborative CALL may render it relatively difficult to quantify its efficacy for the language learner.

Very similar comments apply to facilitative CALL materials as far as effectiveness is concerned. Again, reports from teachers and students using word processing tend to be very positive, but no hard evidence on this appears to be available thus far. In the case of writing classes, it would be relatively easy to investigate the effects of the use of word processors on ESL students' attitudes and skill development. It seems likely that research results will soon be forthcoming in this area. Investigations into the effectiveness of word processing have already been conducted with native speakers, as will be discussed in the chapter on writing.

Chapter 2: Computer Equipment and Systems

In this chapter, an overview will be provided of the basic computer hardware that teachers are likely to encounter. Then, in the second section, other types of hardware that may have important implications for language learning will be described.

BASIC TYPES OF COMPUTER SYSTEMS FOR CALL

There are two fundamental types of computer systems used in computer-assisted education at present: *terminal systems*, that are based on large computers, and *microcomputer* systems, that depend on individual microcomputers. Recently, a variant of the microcomputer-based system has begun to grow in importance: the *cluster* system, in which individual microcomputers are connected to share some common equipment. These three types of systems will now be discussed in turn.

Terminal Systems

Until the last few years, all educational computing systems were based on mini- or mainframe computers. In these systems, students work at individual terminals that are in continuous communication with a single large central computer (in the most sophisticated operations, more than one large computer may form the core of the system). Virtually none of the computer operations are performed by the terminal, whose chief function is to accept student input and display output. Instead, the computational work for each terminal is carried out in the central computer through a process known as timesharing. All the terminals are thus dependent for their operation on the central computer. Modern terminals generally consist of a keyboard and video display unit as a minimum. They may also incorporate touch-sensitive screens, headphones, and other more sophisticated hardware.

Among the systems based on extremely powerful mainframe computers, the PLATO system (Hart 1981; Jamieson and Chapelle 1983) is one of the oldest and best known. At the University of Illinois, for example, two CYBER mainframes are used in tandem and can run approximately 600 PLATO terminals simultaneously. Although most of the terminals are on campus, PLATO users can access the mainframe computer from thousands of miles away via microwave hookups, telephone lines, or the like. Thus, it is not necessary to install a mainframe computer in order to use PLATO; all that is required is the purchase or leasing of the terminals.

By contrast, most systems based on relatively smaller minicomputers require the installation on campus of the minicomputer itself as well as the associated hardware and terminals. A well-known example is the TICCIT system (Hall 1979; Langdon 1980), in which approximately 120 terminals may use the central computer simultaneously. Another example that is widely known in the public schools is the Computer Curriculum Corporation's minicomputer system, which offers a digital speech option for its ESL curriculum.

Microcomputer Systems

Microcomputer-based systems have also been termed 'stand-alone' systems, because each microcomputer is entirely independent, performing the functions of both 'terminal' and 'central computer.' In its most basic configuration, the system resembles a terminal, having a video display and a keyboard as its most obvious components. This resemblance often causes some confusion between terminals and microcomputers in the minds of computer novices. A key difference is that the microcomputer console contains a complete computer 'brain' incorporating the microprocessor and memory units. To add to the confusion, the console, keyboard, and video display are physically separate in some microcomputer models, whereas other models supply all three in an integrated unit.

Each stand-alone microcomputer system must include the above three items plus at least one additional component: an input device for loading the preprogrammed lesson materials into the computer. The input device is usually a disk drive, which will rapidly load programs into the computer memory from the diskettes on which they are stored. Generally, a number of different programs can be recorded on one diskette. When other programs are required, a different diskette is inserted into the disk drive. However, some institutions use standard cassette recorders and cassette tape for program storage, input, and output. This is a much cheaper method, but it is far slower and somewhat less reliable than the diskette/disk drive combination.

There are significant differences between terminal and microcomputer systems. Before we begin to compare them, however, it is important to recognize that both types of systems are generally capable of delivering most of the benefits of computer-assisted learning outlined in these pages. This statement must be qualified, however, as regards the cheaper microcomputer systems. Cassette recorder input/output and the limited memory capacity of cheaper microcomputers both impose severe restrictions, particularly on certain instructional types of CALL courseware.

One major difference between terminal and microcomputer systems is their expense. Although some of the large computer systems have been available for well over a decade, they have yet to make an impact on any but a tiny fraction of the educational community. The purchase or leasing of the terminal equipment for a moderate-sized PLATO learning center would probably involve extensive interdepartmental budgeting and might well stretch the financial means of most institutions. According to Jamieson and Chapelle (1982), terminal purchase prices are around $5500, with telephone connection charges, maintenance, and software leasing charges adding a substantial continuing amount. In most cases, the justification of such systems would require that the CALL materials form a significant and integral part of the school's curriculum.

With most microcomputers, the purchase and other costs are so much lower--between $500 and $1500 per complete diskette-based system, excluding software--that a medium-sized learning center could conceivably be set up by a single department. One mistake that is frequently made is to assume that the hardware represents the only large expense. In the long term, microcomputer purchasers should expect to spend more on software than on hardware. On large computer systems, software tends to be leased rather than purchased. Some of these systems have the considerable advantage at present of offering complete, carefully integrated ESL curricula. The ESL materials currently available for microcomputers generally comprise much less than complete curricula but are more varied in scope.

Terminal systems designed specifically for educational purposes, such as those of PLATO, TICCIT, and the Computer Curriculum Corporation, are generally more powerful than microcomputers. Their special-purpose terminals typically can display more text on the screen, and the system can perform more sophisticated analysis and judging of student answers than is possible with most microcomputers. They also offer convenient centralized storage of programs and student records. The connection to the central computer can provide access to a large array of student aids, sometimes including facilitative features such as an on-line dictionary that is available during other activities. On the other hand, many microcomputers offer features such as color video, fast high-resolution graphics, and sound generators that are not found on some terminals or that may only be available at substantial extra cost. Also, more powerful microcomputers are now appearing that can rival or better the analytical power and screen display capabilities of terminal systems (Tenczar 1981).

Unfortunately, while the centralization of terminal systems offers important conveniences, it also renders them vulnerable to temporary but catastrophic breakdowns. Since all the terminals are dependent on the central computer hardware, an equipment failure here may shut down every terminal. Modern computer hardware is extremely reliable, so that this will be a rare occurrence. However, if the computerized material forms an integral part of the curriculum, such breakdowns will be very disruptive. Ideally, all the centralized hardware should be installed in duplicate to form a backup system, but this is rarely done because of the additional expense. With microcomputer systems, this problem does not arise. Since they are completely independent in a stand-alone configuration, hardware failures in one system have absolutely no effect on the others.

Weighing all these factors, most authorities in the field of educational computing are convinced that microcomputers hold the key to the future. As early as the spring of 1982, a U.S. Department of Education survey showed that microcomputers outnumbered terminals in the public schools by four to one, with the ratio rapidly on the increase. Even earlier, a leader in the field of educational computing pointed out that

> microcomputer stations offer more performance at a fraction of the cost of a terminal networked to a central time-sharing system. (Tenczar 1981)

This statement is certainly true of the more sophisticated microcomputers now being used for educational purposes, such as the Regency models. The movement toward microcomputers has also been acknowledged by the appearance of courseware adapted from larger systems such as PLATO to run on microcomputers (Wyatt 1983a).

Cluster Systems

The lack of centralization of stand-alone microcomputer systems does have its drawbacks, as indicated above. For example, student record keeping and class management are not as convenient as they could be. To illustrate a second problem, consider a stand-alone learning center with ten microcomputers and disk drives. With some types of programs, the diskettes on which they are recorded must remain in the disk drive while students are using them. If all students are to use the same program simultaneously, this would require ten copies of the same diskette. Clearly, multiple diskette purchases would represent a large expense, and diskette storage might be a considerable inconvenience in a sizable learning center.

The attempt to combine the benefits of terminal and microcomputer systems has led to the development of the cluster concept. In one type of cluster system, individual microcomputers remain as the basis, but they are all connected to a single large memory unit (generally a hard disk). All courseware is stored in the central memory, and copies can be down-loaded into each microcomputer as needed. While students are working at the microcomputer, they have access to study aids such as an on-line dictionary in the central memory unit. As students complete activities, score and performance information can be transmitted to the central unit for convenient storage and use by the teacher.

Microcomputers grouped in cluster configurations seem certain to be the future direction for computer-aided learning systems. Control Data Corporation, for example, has clearly recognized the advantages of microcomputers in introducing the Control Data 110, a new PLATO learning station designed to function both as a terminal and a microcomputer. Similarly, Hazeltine Corporation has now introduced the new MicroTICCIT system, which is based on modified IBM Personal Computers as the learning stations. Using the term 'star system,' Marty (1983) reports developmental work on another form of microcomputer-based cluster system at the University of Illinois.

Despite the benefits and convenience of cluster systems, a few words of caution are appropriate here. Some of the approaches to cluster systems assume that the individual microcomputers will no longer need their own disk drives. In my view this is a mistake, since individual disk drives provide a very useful form of backup system in case of breakdowns in the central memory device. For the same reason, it is also necessary to have at least one method of making a backup copy of the entire central memory contents. Cumulatively, these requirements make a cluster configuration considerably more expensive than stand-alone systems.

OTHER COMPUTER HARDWARE

A detailed treatment of the other types of hardware, or *peripherals*, that can be added to the basic computer to provide extra possibilities for students and teachers is beyond the scope of this book. However, a brief outline of the main peripherals that have implications for language teaching has been provided in the section below. This should enable the reader to grasp their potential for contributing to different areas of ESL. In some cases, peripherals will be described in more detail in later chapters as this becomes necessary to the discussion.

Input Devices

In the basic microcomputer system described above, there were two different input devices: the keyboard and the *disk drive* (or cassette recorder).

The cluster system had an additional input device: the *hard disk* drive. The difference between the two types of disks is essentially their capacity to store the programs and data that constitute courseware. Memory capacity is usually measured in bytes, where one byte is the amount of memory necessary to store a character such as the letter *b*, the number *6*, a question mark, and so on. The most common microcomputer disk drives operate in such a way that they can store in the neighborhood of 150,000 bytes on one diskette (this is usually abbreviated to 150 KB).

In contrast, there are hard disk units available for microcomputers that will store up to 20 million bytes (abbreviated as 20 MB). In other words, one hard disk unit can provide the storage equivalent of over 130 diskettes. Of course, both types of disk units can function both as input devices--supplying ready-to-use educational programs and data to the computer--and output devices. Where output is concerned, students' score and progress information can be sent out from the computer for storage on disk or diskette.

As the primary input device for the student, the keyboard can be enhanced by the provision of *dedicated function* and *programmable function* keys. Dedicated function keys are those that have been added to the standard typewriter layout to provide specific educational functions at the touch of a single key. The PLATO keyboard, for example, has a number of useful keys, including a 'help' key that students can press when necessary.

Most microcomputers are designed for general purpose use and do not have keys with specific educational applications. On the other hand, microcomputers often have programmable function keys such as an 'escape' key, which can be used as a flexible means of providing help. Certain microcomputers have whole banks of programmable keys, which can be used to speed up multiple-choice answering, for example, by defining consecutive keys as '*a*,' '*b*,' '*c*,' and the like. Add-on *key strips* or banks of touch-sensitive 'keys' are also available, some in larger formats for younger learners, to make the input of limited types of answers quicker and easier.

A further simplification of the input process, particularly useful in some types of activities, is direct screen input. One way to achieve this is to use a video monitor that has a thin, transparent touch-sensitive panel laid over the screen. In order to respond, students need only to touch the screen with their fingers (Marty 1981). These devices clearly have a number of worthwhile applications in activities such as a 'scrambled sentence' exercise, where students reorder the sentence simply by touching the words in the correct sequence. They also provide a means of drawing directly on the screen, which opens up other interesting applications. Touch-sensitive screens have also been used to eliminate the keyboard entirely; whenever a 'keyboard' is needed, the alphabet is simply displayed on one half of the screen.

Similar effects can be obtained at much lower cost through the use of a *light pen*. This is a wand, connected to the computer, that the student uses to touch or 'draw' on the screen. Its advantage (other than low cost) is that it will operate with any standard video monitor or television.

Before leaving the subject of 'drawing' on the screen, several other peripherals should be mentioned. The *graphics tablet* consists of a flat tablet, equipped with electromagnetic sensors and a stylus. When the tablet is connected to the computer, under the control of the appropriate computer programs, drawing on the tablet with the stylus produces the equivalent movements on the video screen, and the graphics can then be stored on disk or diskette for future use.

Similar although much more limited effects can be obtained through a *joystick* connected to the computer. This is a short, pivoted control stick attached to electric potentiometers that sense its direction and movements. With the aid of appropriate computer programs, it is then possible to 'draw' on the screen or indicate answers on the screen by using the joystick. The same effects can be obtained in a clumsier way by the use of *paddles* attached to the computer. These are rotary controllers; one moves the pointer horizontally on the screen, and the other moves it vertically. Both joystick and paddles have buttons that can be pressed to indicate that the desired position has been reached.

In contrast to this array of well-developed text and graphics input devices, voice input is still in a state of relative infancy. At the simplest level, the student's voice can be recorded with a computer-controlled audio cassette (or videotape recorder) for later review by the teacher. At a slightly more sophisticated level, students' spoken responses can be recorded and played back using a *random access* audio unit. One such device uses large floppy diskettes for storing the recorded speech.

However, the greatest future potential for computer-assisted learning applications clearly lies in providing the computer with the ability to analyze students' spoken input. A prerequisite for this function is a computer-controlled *digitizer*, which converts the speech sounds and characteristics into a digital form similar to that in which all computer information is stored. The voice input can then be analyzed, manipulated, and stored by the computer. *Voice recognition* and analysis of this sort are already possible in a very limited way. For example, students can answer multiple choice questions in the most convenient fashion simply by saying the letter of their choice! More detail on why this is a limited sphere of applications at present will be given in the section on speaking skills. It seems clear that extensive voice input will eventually become possible, but there is still considerable progress to be made in this area before it can be widely used in language education.

Output Devices

In describing the basic computer systems, the most obvious output device mentioned was the *video display unit*, whether a standard television set (color or black and white) or a video monitor (color, black and white, green screen, amber screen, etc.). In general, educational mainframe or minicomputer systems have video units that can display relatively large amounts of text with excellent clarity; their screens can accommodate about the same amounts of text as a regular printed page.

Microcomputer video capabilities are almost invariably much more limited, although at least one elongated type of monitor is now available that approximates the printed page in shape as well as capacity. In practice, however, most microcomputer video units are still limited to a display capacity that is only 25-50 percent of that of a regular printed page. By way of compensation, some microcomputers have fast high-resolution color display capabilities.

One dilemma should be mentioned before leaving this topic. Some types of courseware use black letters on a white background, simulating the printed page. This gives superior readability from a distance and is best for large group or whole class applications, but the glare is very uncomfortable at close quarters. In single student or pair work, white text on a black background is much preferred. It seems wise to offer users an opportunity to select the type of display they need, but educational programmers have generally failed to do this so far.

Of course, the microcomputer systems described above also included a second output device: either a *disk drive*, a *hard disk drive*, or both. Although their principal function is that of transmitting the ready-to-use lesson programs to the computer, they can also operate as output devices when students' records and scores are transferred from the computer for storage on diskette or hard disk. Several types of peripherals have these dual input/output functions. Both text and graphics output can be stored on disk drives as well as displayed on the video screen.

One extra feature that is usually added to at least one computer system in a classroom or learning center is a *printer*. This is useful to the teacher for obtaining a paper copy of student records or listings of computer programs. If students are using word processing extensively, more than one printer will probably be necessary. Certain types of courseware also offer the option of printing out assignments for each student, on the basis of performance during the current session at the keyboard.

In terms of audio production, most microcomputer systems have a *sound generator*--essentially a synthesizer--that can produce simple musical and sound effects. As far as speech output is concerned, the simplest method of combining it with computer-assisted learning is to use a standard cassette and cassette recorder under computer control. A step up in sophistication is gained by using a *random access* audio playback device. In their simplest form, these devices offer direct access to any part of a prerecorded audio program, permitting the kind of instant 'branching' that is such an advantage in CALL materials.

Much more powerful applications are potentially feasible through *artificial speech*. At one level, this can be achieved through the playback of previously recorded--or more accurately, *digitized--speech*. Digitizers are capable of producing very high quality, natural-sounding speech. The type of artificial speech with the greatest potential is true *speech synthesis*. Through the use of a computer-controlled synthesizer, speech output can be generated from prestored phonemes and allophones, with appropriate suprasegmentals added at the word, phrase, and sentence levels. Synthesized speech of a quality suitable for producing model utterances in the target language is currently not an affordable, practical reality. However, synthesized speech of sufficiently high quality for giving directions in the student's native language is already being used in some projects (Van Campen et al. 1981).

Movie quality video combined with audio output can be achieved at the simplest level with a computer-controlled *videotape* player. However, a much more powerful device for these applications is the *videodisc* player under computer control. Some units use a separate screen for the videodisc material, while others permit the combination of computer text and graphics with videodisc still frames or moving sequences on a single video screen. Its enormous still frame capacity, together with freeze-frame, slow and reverse motion, dual independent audio tracks, and direct frame access capabilities, provide the videodisc with impressive potential in language-learning applications. In addition to computer-assisted learning, the stand-alone videodisc player with wide screen television holds considerable promise for standard class teaching. Fully integrated with traditional courses, videodiscs could provide very attractive alternatives to the usual textbook-based methods of presenting and practicing language and stimulating student language use in the classroom.

Chapter 3: Introducing CALL at Your Institution

The three key elements in the introduction of computer-assisted learning in an educational institution are *training*, *software*, and *hardware*. Ideally, that is the proper order in which they should be approached once the decision has been made to become seriously involved in CALL. Sometimes the last of these--the selection of hardware--is already a *fait accompli*. In some cases, the ESL department is being given access to computers that have already been selected and purchased by other departments. This is unfortunate, because the basic requirements for language-oriented computer systems are significantly different from those of science, mathematics, or data processing. If possible, it is strongly recommended that decisions concerning hardware be postponed until after teachers have been formally trained in CALL and careful consideration has been given to the software questions described below.

TEACHER TRAINING

This is the single most neglected element in the area of computer-assisted learning. An ESL department wishing to begin using CALL will need at least one key staff member with a considerable knowledge of the field. A surprising amount of self-study can be accomplished, provided the person has extensive access to a microcomputer or terminal and considerable enthusiasm. Knowledge gained in this way will then need to be expanded and reinforced through formal training. Experience suggests that a course of study in computer-assisted learning equivalent to four to eight credit hours, or five to ten days of intensive training, will be adequate, provided that it is preceded by a considerable amount of self-study. Without this preliminary self-study, the recommended course lengths would need to be approximately doubled.

At this juncture, the most common error is to assume that the necessary instruction will be gained in a 'computer literacy' or 'introduction to computer programming' course. Nothing could be further from the truth; frequently, an entire semester course of this nature supplies virtually no information of any utility for computer-assisted education. Instructors in these courses are almost invariably from computer science or mathematical backgrounds, have no awareness of the requirements of computer-assisted learning, and spend the time with concepts and programming commands of little or no value to educators. Instead, key staff members should be careful to select a course that specifically focuses on educational computing for the humanities. The ideal, of course, is a program limited specifically to computer applications in language learning. Fortunately an increasing number of schools and colleges are beginning to offer such courses on a semester or intensive basis.

With this level of training accomplished, the key staff member is now in a position to approach the next question, that of software. However, the training process has an equally important component that should not be overlooked when decisions on software and hardware are in the forefront: the training of other teaching staff who may use CALL in their work. Failure to provide the necessary opportunities to all the teaching staff is an invitation to disaster. Frequently, teachers will feel threatened by a medium they do not understand. Many will not be enthusiastic about techniques that are all too often perceived as a step toward replacing them, as evidenced by a comment overheard at a recent conference:

> This is like allowing French aristocrats to watch the construction of an elaborate guillotine while telling them it will be used to sharpen pencils!

Questions about teacher replacement and other perceptions of the 'threat' of CALL must be faced directly and defused as part of the training process.

It is easy to be lulled into a false sense of confidence by ready-to-use software accompanied by claims that 'no computer knowledge is required' by its users. This may be true as long as nothing unexpected ever happens. Unfortunately, experience amply demonstrates that the unexpected is always likely to occur. Teachers need enough training to gain a basic understanding of what is happening when they are using CALL materials, a familiarity with CALL techniques, and the confidence that they can recognize and respond to the common problems they will encounter. Armed with this type of knowledge, teachers are in a position to control the new technology; without it, the technology will intimidate and control them. As an absolute minimum, two to three days of intensive training or the equivalent of two to three credit hours of classes are recommended for all staff members who are to use computer-assisted materials. The bulk of this training will generally need to be postponed until the computer equipment arrives so that the proper hands-on experience can be provided. By this time, the key staff member(s) may well be able to conduct the necessary training.

SOFTWARE DECISIONS

During their training and self-study, the key staff members will probably have been exposed to a wide variety of ESL software. They will also have received advice on how to evaluate software themselves and how to locate reviews by others.

Software evaluation is a skill that is learned through extensive practice and experience. It has received a great deal of attention recently, with numerous checklists having been suggested to aid in the process. This material will not be duplicated here, but the references and appendix provide sources of information (for example, see Coburn et al. 1982).

Now is the point at which the key staff members must bring their expertise to bear on the commercially available courseware. Will it supply all the currently desired CALL curricular requirements? If so, the selection of hardware may well be automatically settled because of the problem of *transporability*. There is an ever-increasing choice of computers available today, but unfortunately diskettes that are recorded on one model of computer will generally not operate properly with any other model or brand of computer. Even within a single company that offers several models, there is frequently no compatibility between them except where a new model is actually an updated version of an older one.

There are several basic problems here; two of them are diskette format differences and computer language differences. Up until now, courseware has frequently been produced for use on one specific computer only. Few packages have been reprogrammed in multiple versions so that they can be used on a variety of computers. Therefore, the selection of any extensive courseware package is likely to predetermine the model of computer that must be acquired. Conversely, if the hardware has already been obtained, and a desirable courseware package is found that runs on a different computer, there is generally little prospect of persuading the publisher to make it available for another computer. This is why it can be such a serious mistake to purchase hardware before the appropriate training of key staff members and investigation of software have been completed.

On the other hand, it is quite possible that after reviewing the available courseware, a department might conclude that sufficient material of the kind desired was not available for any computer. At this point, departments wishing to proceed with CALL would be faced with a choice between hiring a software development house or designing and programming their own courseware. The first alternative would be extremely costly but would leave open a wide range of hardware options; with outside programming expertise, many of the available computers might be feasible choices.

The second route--that of developing courseware within the department--leads to a further decision among three major approaches to courseware production: using a *general purpose programming language*, an *educational programming language*, or an *educational authoring system*. The development of courseware using a general purpose programming language offers the maximum in flexibility and control. Virtually all the decisions about program content, approach, and style are entirely at the programmer's discretion. Also, the widest possible selection of computer hardware is available, since general purpose languages like BASIC can be found on almost all computers. Working with general purpose languages is the most demanding route to courseware development. The training of programmers to the necessary level is measured in months, or perhaps years, and even then the actual process of programming takes the longest of the three approaches.

The second possible route to in-house courseware development involves the use of an educational programming language such as PILOT or EnBASIC. Such languages are specifically designed for educational applications and include powerful built-in features and commands that can greatly facilitate courseware development.

The similarities end here, however; there are wide differences in the capabilities and complexity of the various educational programming languages. Even a novice, for example, can quickly learn how to use the answer-judging routines that are immediately available with PILOT, because PILOT was deliberately developed as a simplified programming language. This reduces both the preliminary training period and the time taken to program courseware. The disadvantage is a relative loss of control over some features of style and approach in the resulting courseware.

With PILOT, for example, the programming language itself is heavily oriented toward tutorial and drill-and-practice types of activity. PILOT is now available on a growing range of microcomputers, although there has been a tendency to introduce a number of new commands in each microcomputer version--a tendency that runs counter to the original intent.

EnBASIC is the first in what will undoubtedly be exciting new developments in educational programming languages for microcomputers. It is vastly more powerful and flexible than PILOT but is correspondingly more difficult to learn and use. At present it also suffers from the disadvantage of being available on only one microcomputer.

The third possibility for in-house development --using educational authoring systems--is even more restrictive. With an educational authoring system, much of the structure of the program is already provided. Essentially the courseware developer is now working with a template, slotting the language activities into such existing formats as multiple-choice or true/false exercises (Holmes 1983). All such systems are necessarily restrictive, but some are relatively flexible, while others work with very rigid templates. On the positive side, such systems do not require the courseware developer to do any programming at all. Quite polished-looking programs can be produced by a non-programmer with just a few hours' experience on the system, and the speed of production of CALL materials is truly impressive.

A decision to use a specific authoring system greatly limits the choice of hardware. Many systems are available on only one or two computer models. This is another instance of the importance of reaching software decisions before venturing into the arena of hardware.

SELECTING HARDWARE

Only after the necessary training is accomplished and software choices have been made can a decision be reached on the most appropriate computer systems and peripherals for purchase. As explained above, the decisions on software may already have narrowed the hardware possibilities to a few models or even a single system. If a choice is still available, the decision is likely to involve complex factors that are beyond the scope of this discussion. However, two important features that are of crucial importance to language learning will be outlined.

The first feature is relevant when the intention is to develop some in-house software in the computer's built-in language, generally a variant of BASIC. There are at least as many varieties of BASIC as there are computers, and different versions may have widely different capabilities. From the language-learning viewpoint, one of the most important is the ability to handle words, phrases, and sentences; in computer terminology, these are referred to as 'strings.' Thus, it is important that the computer language should handle strings well. These abilities are of little importance in science and mathematics applications, so that if computer selection is left up to these departments, the hardware may be poorly adapted for language courseware development. For these and other reasons, it is important for language departments to be closely involved in the purchase of the computers that they will be using.

The second consideration has already been referred to in an earlier section: the choice between diskette-based and cassette-based microcomputer systems. Diskette storage is far more powerful and imposes no restrictions, so that the whole range of possible types of CALL is available. With cassette storage there is still considerable potential, but some types of instructional activity may be much reduced in effectiveness and others may not be feasible at all.

Section B: Computer-Assisted Learning in Specific Areas of ESL

Chapter 4: Reading and Vocabulary

Using the framework provided by the first part of this book, we will now focus on specific language activities that are possible in CALL. First, however, a word is in order regarding the status of ready-to-use software. At present, the quantity and quality of commercially available courseware are far from ideal. Relatively little of the potential of CALL has been realized in published materials, but some large course projects are now nearing completion. Other software, in a less polished form, is available through individuals or professional organizations. Some of these materials are ready to be used directly by students, whereas others represent interesting ideas that are not really developed to the level of practical classroom implementation.

Since the objective of this book is to examine the practical potential of computer-assisted learning in ESL courses, it would serve no purpose to limit the discussion to existing software. The reader should bear in mind that some of the materials in the following sections are already available commercially, some are in a prototype or unpolished form, and many of them have yet to be developed. For those who are primarily interested in ready-to-use materials, an appendix of software publishers and other sources has been included. Up-to-the-minute information can best be obtained by writing to these sources or by consulting the standard guides that are now available (Hertz 1983a; Sauve and Schnuer 1983; Wyatt 1984). For those readers whose interests lie in developing their own materials, it is hoped that the following chapters will serve as a modest source of inspiration.

In dealing with the language areas and aspects in depth, we have distinguished between CALL activities related to standard, familiar classroom practices and some newer, more innovative computer-assisted possibilities. It will be helpful for readers to consider for themselves how the individual activities fall into the three main categories we have already discussed: instructional, collaborative, and facilitative CALL. We will be commenting further on these categories where appropriate. Often the more familiar computer-assisted activities are instructional in nature, whereas the innovative ones are collaborative, but this is not always the case.

POTENTIAL AND LIMITATIONS

Reading/vocabulary is one of the areas of the curriculum where computer-assisted learning holds the greatest promise (Wyatt 1983b). By its very nature, reading is a highly individual and idiosyncratic process. Even in a class where the proficiency levels of the students are quite similar, reading speeds and comprehension abilities tend to vary quite widely. With many class activities, it is necessary for the teacher to choose an average speed of presentation. Experienced teachers realize that this compromise is particularly unsatisfactory for the reading class. Whatever average speed is selected, it will be too slow for the abler students--not challenging and developing their skills as it should--and frustratingly rapid for the less able students. The reading class almost demands a more individualized, student-centered approach.

This need was the motivating force behind the development of 'reading laboratory' materials such as those of Science Research Associates (Parker 1963). However, a much higher level of individualization, together with all the other advantages of

CALL, can be achieved through the use of a computerized presentation. In this way, a wide range of traditional and innovative activities can be provided in the area of reading skills. A selection of some of the possibilities is described in detail in the following section.

Before outlining these activities, however, some important limitations of most current computer systems must be emphasized. One of the most irksome problems is the limited amount of text that can be displayed on the video screen at any one time. Without the use of special programming techniques, one of the most popular microcomputers in our schools will display only 24 lines of 40 characters, as compared to a typical typed page of 56 lines with 80 characters per line. Some of the newer microcomputers--and specially programmed older models--can display 80 characters on a line. However, the desirability of this is debatable, since the legibility of the text is much reduced. It may well be better to work within the confines of a 40-character screen, which, despite its other limitations, does have excellent readability. This problem can largely be overcome by providing any reading material of more than a page in length in traditional book or loose-leaf form, reserving the video screen for what it does best: presenting information or activities to the student in a dynamic, responsive manner.

A second limitation that some teachers may feel is important is the absence of a spoken presentation of the reading materials, particularly at the beginning level. In many respects, this only appears to be a problem because teachers may consider the computer-based activities as constituting the entire lesson. There is no reason that the lesson could not begin with the teacher's reading the material aloud before moving on to the computer-based phase. If individualized access to a spoken version is desired, the simplest method is to supply an audio cassette and cassette recorder under the student's manual control. Alternatively, the cassette recorder could be controlled directly by the computer through the addition of a simple and inexpensive interface. If more power and sophistication are desired, a random access audio device can be utilized as described later in the sections on listening and speaking.

A third limitation is to be found in the computer's inability to handle relatively open-ended or higher-level interaction with students. Even with less ambitious CALL materials, unplanned or unprogrammed responses will arise from time to time while students are working at the computer, bringing the teacher into play as a resource person and advisor. At the more communicative level, the 'problem' of the computer's limitations is resolved when the CALL activities are seen as only one component of a lesson to be followed by higher-level activities such as summary, discussion, and debate in a traditional manner.

CALL AND STANDARD READING ACTIVITIES

The main focus of many modern reading courses in ESL is the development of a body of reading abilities, skills, and techniques that have been increasingly well defined in recent years. Courses such as *Reader's Choice* (Baudoin et al. 1977), *Reading and Thinking in English* (Moore 1980) and *Skillful Reading* (Sonka 1981) have been based on syllabuses that include *practical reading strategies* such as skimming and context guessing; *general discourse features*, such as anaphoric reference and paragraph main idea; and *specific language features*, such as the notions of cause and effect, or functions like classification and definition. Other aspects of reading that have received attention include *reading improvement* and readiness techniques and *vocabulary expansion*. This section will present some examples of the ways in which computerized materials can contribute to such curricula.

Practical Reading Strategies

One of the skills needed for reading successfully in a second language is the ability to *deal with new or unfamiliar expressions.* In many cases, students should be capable of deducing the meaning from contextual or morphological clues. On the other hand, there will be cases in which the clues are insufficient and the word meaning is crucial to understanding, so that students must use a dictionary.

In many reading courses, the skills of using contextual and morphological clues to deduce word meaning are introduced and practiced at an early point. For example, the presence of an antonymous phrase in the same sentence or the *-er* suffix to indicate agentive meaning may help to elucidate an unfamiliar expression.

This practice can be individualized through CALL along the following lines. The computer displays a sentence or paragraph containing an expression that the student will probably not recognize. The student is asked to try to deduce the meaning of the expression. First, however, the student must indicate whether *any* of the standard clues to meaning are to be found in the sentence. The computer will thus guide students toward the correct *approach* to adopt in handling this type of difficulty. Through a multiple-choice format, the student is then asked to deduce the meaning of the unfamiliar expression. The computer will have a large bank of items, classified by the type of clue that students should be able to recognize and use. As the exercise progresses, the computer will automatically focus the practice on the types of clues with which the student has the most difficulty.

This entire introductory series of exercises could be presented in game format, with the students gaining points or losing them, depending on the accuracy of their work. With the potential for attention to individual problems together with the motivating power of the game element, the computer presentation would represent a considerable advance over a traditional classroom presentation and constitute a valuable instructional type of activity.

However, one of the main difficulties with these word-handling skills is achieving effective transfer from the initial presentations to everyday student use. The computer can provide a powerful solution to this problem, and we will return to this point in a moment. First, let us deal with the related question of dictionary use.

A serious problem for readers in a second language is excessive use of the dictionary. Any dictionary use tends to slow down readers considerably, distracting them from the main task at hand, and the problem is exacerbated by overfrequent use. At the simplest level, the computer can relieve this problem by acting as a rapid reference tool--a facilitative function that has considerable promise. However, with very little extra programming, the computer can also provide day-to-day assistance in transferring the strategies of using context and morphology clues to the students' active repertoire.

This type of *interactive.dictionary* works as follows. The student, reading a passage on the video screen or in a textbook, encounters an unfamiliar word. To obtain dictionary help, the word is typed into the computer. Instead of giving direct assistance, the computer sets the student a multiple choice of several possible meanings and invites the student to use context and morphology clues, if present, to deduce the word meaning. Each time students resort to the computerized dictionary they are asked to develop their skills in handling new expressions. The whole process can take less time than locating the word in a standard dictionary.

Other reading strategies such as *reading according to purpose* lend themselves to instructional CALL activities. For example, *skimming* a reading passage to get a grasp of general meaning or *scanning* rapidly through it for one or two specific items of information are both techniques that can be practiced in an individualized manner with CALL. As explained previously, the relatively long passages that would be required for this type of exercise would probably best be provided in booklet form, with only the interactive questions and answers being displayed on the computer screen. Shorter introductory items could probably be presented entirely on the video display.

One reading strategy that appears to be an important component of fluent reading is *prediction*: the continuous formation of hypotheses about what is coming next, based upon the material already encountered. Activities to encourage and practice this have been attempted in textbook form, but the computer is clearly a much more suitable medium for this. In one format, students read a certain number of sentences and are then given a choice of several possible examples of a 'next sentence.' If correct, they continue the exercise in similar steps. If their choice was not the best answer, however, the computer can draw attention to the features of the preceding sentences that mitigate against that choice. Hints designed to stimulate students' thinking and promote the predictive approach can be presented, followed by a return to multiple choice of the remaining possibilities.

One of the strengths of screen-based exercises can be seen here in the ability to continue presenting the same multiple choice item to students. Because their answer is corrected without revealing the right solution, this constitutes a highly economical use of material. In the same way, quite extensive hints and suggestions can be provided for the slower students without impeding the progress of the abler ones.

General Discourse Features

Many modern reading courses cover a wide range of discourse features such as anaphoric reference, logical connectives, and paragraph structure and main idea in a very general way. (Some of these features may be covered in a much more specific, detailed manner, as outlined in the next section.)

For example, students' attention is usually drawn to the range of logical connectives like *therefore, on the other hand*, and *however.* Rather than presenting them in a systematic, sequenced manner, reading courses that operate at the general discourse level are usually limited to pointing out the importance of the function of these connectives and offering practice with a small number of examples.

In working with this type of general discourse feature, traditional textbooks suffer from two significant disadvantages. First, when new features are introduced and practiced, there tends to be far too little practice material for any but the most able students. In terms of the economics of publishing, this is understandable; each practice item involves a stretch of *discourse* rather than a short phrase or sentence, so that a single exercise occupies a much larger space than usual. The second problem with a traditional textbook presentation is the familiar one of encouraging transfer of skills from the context of exercises to the student's everyday repertoire. Frequently the general discourse features receive no further systematic attention once they have been initially introduced and practiced.

The computer can assist in solving both these problems. In place of the traditional textbook, the computer-aided course could provide a booklet with a variety of reading passages to accompany the programmed exercises. One major advantage of the separation of reading materials from exercises is that the reading materials in the booklet can be used and re-used for a variety of different activities. Rather than being tied to any particular exercise, the reading passages function as multipurpose materials. Shorter exercises can be based entirely on the video screen, while exercises requiring longer discourse passages will direct the student to the appropriate page and paragraphs in the booklet.

A second major benefit of the computer-assisted approach lies in the computer's ability to store information from one lesson to the next on the student's progress in different skills. This provides a significant advantage in helping students integrate the skills into their regular reading. Instructional CALL materials of this nature can make an individualized, automatic selection from a range of exercises at the start of the next lesson, giving students further practice on their areas of weakness. Specific general discourse features can thus be recycled until students begin to demonstrate that they recognize and understand them, at which point the computer will shift the focus of activities in subsequent lessons to new features.

Operating in this manner, CALL materials can focus on a large number of general discourse features. For instance, the familiar *pronoun reference* type of exercise can be presented entirely on the video screen as follows:

> Research studies have shown that the beneficial effects of pesticides can be offset by *their* environmental danger. Government laboratories are currently investigating insecticides such as dieldrin and DDT.
>
> *their* refers to
> a. research studies
> b. beneficial effects
> c. pesticides

With the screen-based version of the exercise, the meaning relationship between *their* and *pesticides* can be shown dynamically through animation or graphics. When the CALL activities are accompanied by a booklet with further reading materials, far more practice items than usually possible in a textbook could be provided for students having trouble with this type of anaphoric reference.

A particular problem for ESL students in expository reading is understanding when different expressions are used as *synonyms*. Two sample questions to focus student attention on this area, again based on the above passage, are:

a. Which expression is used as a synonym for *pesticides*?
b. Which two words are also related in meaning to *pesticides*?

CALL materials of this kind could begin with both context and questions presented on the screen. However, they could then move on to longer passages in an accompanying booklet to help achieve the transfer of this reading skill to realistic contexts. Other familiar exercises on general discourse features such as paragraph main idea, paragraph structure, and general communicative function of sentences and paragraphs can also be enhanced through computerization.

Specific Language Features

Some recent reading courses are based on a much more detailed and systematic syllabus of specific language notions and functions. In the case of notions such as cause and effect, these courses present associated vocabulary (*result, prevent*), connectives (*consequently*), and syntax. With functions such as definition, process description, or classification, similar features are addressed, with additional attention to the structure of paragraphs and passages that present the functions.

All these aspects of notions and functions can be introduced and practiced in instructional CALL programs. With one of the above functions, for example, the computer may first present and explain the function. Using screen- or booklet-based materials, the associated vocabulary, connectives, and syntax are directly practiced. Finally, the function may be demonstrated at the discourse level with attention to its role in paragraph or passage structure.

Let us consider a model exercise in which students are being asked to recognize and understand the important function of classification in different paragraphs. For each paragraph, the students are given an information transfer task in which they demonstrate their understanding by completing a diagram showing the different categories of the classification. In a typical textbook, there might be four paragraphs and diagrams in the exercise. The limitations of the traditional textbook are again apparent in such a case. Some students will be able to transfer the concept of classification from their native language reading skills and will require no more than one or two paragraphs to confirm that transfer, after which further work would be superfluous. Other students may be unfamiliar with classifications and will require more than this handful of sample paragraphs and the time to work with them to grasp the concepts properly.

The computer obviously has the potential to individualize this process so as to provide the correct pace and amount of practice for students with quite different abilities. Where a large number of practice items are necessary, the computer can be programmed to select paragraphs of classification from the whole of the accompanying booklet. If a student clearly needs more work by the end of the first class, information can be recorded so that further classification exercises will automatically be included in the next session for this particular student.

Another important point should be made regarding the usefulness of CALL in exercises such as the above. When the student is transferring information in the text onto a classification diagram, a wrong decision toward the top of the diagram--early in the logical train--can make it impossible and a waste of time to attempt to complete the rest. Immediate feedback in the computerized form of the exercise, with rejection of wrong answers or confirmation of correct ones, would prevent the student from building more wrong decisions on top of the original mistake.

Reading Improvement

Many second language students have a tendency to read very slowly, approaching text as a word-by-word deciphering task in which it is crucial to establish the meaning of each lexeme before moving on to the next. Such an approach inhibits the development of reading comprehension and has led to a variety of materials designed to improve students' reading techniques and speed.

At the simplest level, the basic methodology has been to provide regular practice in reading short, easy passages under teacher timing and supervision. Fry's *Reading Faster* (1963) and the SRA 'speed builder' reading laboratory component (Parker 1963) are typical examples.

At a more sophisticated level, texts such as *Reading Improvement Exercises for Students of ESL* (Harris 1966) also aim at specific techniques for improvement: reading in meaningful word groups, expanding the size of those word groups, and grasping them with a single eye fixation. However, the print medium is dramatically limited in this regard, since on a printed page there is virtually no way to control what the student sees and does. This has led to the development of educational technology such as the tachistoscope, capable of projecting words and phrases rapidly on a small film screen in front of the student. At best this is a clumsy, expensive, and relatively minor advance over print.

For all these speed reading approaches, the computer provides an ideal instructional medium. In the simpler approach, the reading selections can be provided in booklet form. The student touches the keyboard when beginning and when finishing the first passage so that the computer will automatically time the reading. A 'clock face' display on the screen allows the student to check on the time at any point while reading. Comprehension questions are presented interactively on the video screen. The answers are scored immediately, enabling the computer to direct the student to a reading passage that will provide just the right amount of challenge for the next exercise. Information is stored at the end of the lesson for future practice sessions.

In terms of the more sophisticated approach to improving specific reading techniques, the video screen provides a much more effective, controllable, and flexible medium than either print or tachistoscope. For example, meaningful word groups can be highlighted in turn in a sentence on the screen, or the meaningful groups can be presented in sequence vertically underneath each other as in the following:

For example,
meaningful word groups
can be highlighted in turn
in a sentence
on the screen
or
the meaningful groups
can be presented
in sequence
vertically underneath each other.

Among the many advantages over the print medium are the dynamic potential of the video screen and the ability of the computer to adapt the speed of presentation and length of the meaningful groups to challenge each student's individual abilities.

In connection with this discussion of screen presentation of text, it is interesting to note two futuristic possibilities that may have implications for language education. One is the well-known prediction that the print medium will gradually be replaced for most purposes by improved video screens, so that printing will only be done 'on demand' for individual customers who have previewed material on the screen and would like to have their own print copy. This change will be driven in part by economics--the inexorable upward trend in the cost of books.

The second possibility is a permanent change in the standard format for displaying text if the video screen becomes the predominant medium for readin[illegible] Many of the accepted standards regarding the appearance of the printed page, such as the spare use of color and graphics and the large number of words in each print line, were a product of economic considerations. When computer storage becomes the general rule, the reasons for many of these standards will no longer apply. In particular, sentences could be printed in meaningful word groups and a vertical format without requiring significant extra expense or storage space (Geoffrion and Geoffrion 1983).

Vocabulary Expansion

Work with vocabulary is generally an inextricable component of reading courses and textbooks. Morphology is often taught systematically, and this is one area in which instructional CALL materials can make a contribution. Affixation and its associated spelling changes can be effectively introduced through the dynamic capabilities of the video screen. The meaning clues provided by affixes can then be targeted for practice, as described in the 'Strategies' section of this chapter, until they are transferred to the student's active repertoire.

Computer-assisted techniques can also provide a simple and effective means of checking at the end of each reading unit that the appropriate new items have entered students' active and recognition vocabularies. Through computerized post-tests, students can be given additional on-the-spot practice with expressions they find difficult. These problem items can then be automatically recycled by the computer for attention by individual students in the next reading unit.

Generalized vocabulary expansion materials can also be useful in learning idiomatic expressions or with students who have relatively poor vocabularies. It appears that CALL techniques for vocabulary improvement result in more rapid learning with higher and longer-term retention. This may be due in part to the enjoyable types of activity that are possible on the screen, including game formats. One unfortunate feature of some existing vocabulary games should be avoided: the tendency to present items without a proper context. An attractive feature of some of the vocabulary game programs now available is the provision for teacher input, so that teachers can supplement or entirely replace the original vocabulary contents with their own materials. Before leaving the subject of games, it should be noted that it is easy to misunderstand their nature. Many educational games are purely instructional; essentially, they are an attractively presented form of drill-and-practice.

NEW POSSIBILITIES IN THE READING CLASS

In the previous section we looked at some of the ways in which the computer could enhance relatively familiar class activities. It will be noted that most of the CALL applications outlined so far have been instructional. Now we turn to some of the roles the computer can play that are more striking departures from current classroom practice.

One of the most popular types of commercial software among personal computer users is the fantasy adventure. In one of the best-known variants, the users play the role of heroic explorer of an underground empire. Using simple commands, the users tell the computer what to do next: 'go north,' 'enter room,' 'attack thief,' and the like. The computer gives detailed descriptions of their current location and surroundings, state of health, accumulated wealth, and other pertinent facts. All the information that the user needs to read, understand, and act on to survive is provided in discourse form on the screen. The object of the adventure is to explore the empire, amass treasure, and stay alive by fighting or fleeing from various unsavory characters. Well-programmed fantasy adventures are often highly addictive to users of all ages.

It can readily be seen that the user of a text-based adventure is doing many of the things we would like our students to practice in reading classes. We will refer to this type of activity, when used in an educational setting, as *adventure reading*. It is collaborative in nature, creating an environment in which the student takes the role of initiator. ESL students find that the materials written for native speakers are highly motivating despite linguistic obstacles such as the sometimes difficult and irrelevant vocabulary of a 'dungeons and dragons' nature. The use of programs such as Infocom's *Zork* can be recommended with students even at low intermediate proficiency, because the self-pacing element of computer use allows them time to work at a comfortable speed. How much more effective adventure reading materials would be with more relevant vocabulary and careful attention to developing the whole range of reading skills!

Two cautionary notes should be made with regard to the adventure reading programs that are currently available. One problem is that many of them are graphics-based and provide little or no text for the student to read. A second caveat is that they accept only 'pidgin English' commands from the student ('enter room') and will *reject* commands that include articles ('enter the room'). This is a relatively minor concern in a reading class, but it unfortunately prevents the use of the current fantasy adventures in other aspects of the curriculum.

A second innovative use of CALL is to involve the student in *creative reading* experiences. The computer might begin by providing the student with a menu of several different 'story' titles to choose from. Once the selection is made--for example, 'murder mystery'--the first few paragraphs of the story are displayed on the screen, followed by several possible actions in a multiple-choice format. Based on the student's selection, completely different stories now begin to unfold, with several more paragraphs followed by new choices. In this way, students can participate in the creation of the story and adapt it to their wishes. At the same time, the notions, functions, rhetoric, and vocabulary in all the possible branches can be keyed to the reading curriculum. Thus, students may be working in a highly motivated manner with a number of carefully selected reading skills.

A number of variants and extensions of this type of activity are possible. For example, if a printer is attached to the computer, the unfolding story (without the menu selection components, which appear only on the screen) can be printed out for rereading and further activities planned by the teacher. Similarly, comprehension questions or other assignments could be printed out.

Both creative reading and adventure reading are related to true *simulations*. These are an attempt to present a model of some part of the real world, albeit on a very limited scale, for the computer user to experiment with. Well-known simulations include a pre-Christian city-state in which the user plays the role of absolute ruler, and a nuclear power plant simulator in which the user acts as chief engineer.

In these simulations, the user is in control and must make regular decisions concerning a restricted number of factors. The results of these are simulated and shown by the computer, and new decisions can then be made on their basis. In the first example, users can find out the effects of decisions about the acreage of crops to be planted or the size of the rations during famines, while in the second they may suffer a meltdown while trying to start their nuclear reactor too rapidly.

Simulations clearly offer opportunities of a collaborative nature for the reading class that are similar to those with adventure and creative reading programs. However, they may hold even more promise in speaking and writing activities, as described later.

Virtually all reading curricula include some emphasis on the understanding and following of written instructions, and this skill is particularly important in many vocational ESL programs. The computer can offer two innovative approaches to developing students' ability to *understand instructions*. In the simpler approach, CALL materials can make use of the video screen to demonstrate the consequences of the students' actions in a visual, dynamic way. In one such exercise, students are referred to written instructions, perhaps directly to a page of a guidebook or manual that is important to them. Using a divided screen, the computer displays questions on the bottom half of the screen relating to the instructions the student has just read. The top half of the screen shows a graphic that demonstrates the results of the students' answers. Serious misunderstandings, such as heating a container before removing the cap, would produce dramatic and memorable results!

In a more sophisticated implementation, the student could be provided with realia linked electronically to the computer. For instance, the components of a valve could be provided along with instructions for its reassembly. Following instructions in book form or on the computer screen, students would try to reassemble the valve. Mistakes would be sensed by electronic contacts embedded in the components and transmitted to the computer, which would immediately attract the students' attention and explain the problem. This type of apparatus and technique might well be useful for vocational training in a corporate environment.

It should be apparent that reading and vocabulary constitute an area of the curriculum in which computer-aided techniques have impressive potential. The possibilities include instructional, collaborative, and facilitative types of programs.

Chapter 5: Writing and Vocabulary

POTENTIAL AND LIMITATIONS

Writing is another area of the curriculum where computer-assisted methods can make an immediate and extensive impact. Appropriately used, the computer can relieve both teachers and students of much of the drudgery usually associated with writing classes. At the same time, since many writing activities involve free expression, there are definite limits to the role that the computer can play.

As far as writing is concerned, the computer offers its greatest immediate potential in the facilitative role of *word processor*. Used as a tool in the creation, correction, and editing of writing assignments, computers offer considerable advantages over the traditional medium of pen and paper. These will be described in more detail in the 'New Possibilities' section. CALL also has an instruction role to play in the writing curriculum. It can be used in a variety of writing activities in which free expression is not involved. In addition, the computer can assist in the preparation of creative writing assignments and in checking them before they are submitted to the teacher.

In the near future, however, the computer will remain limited in its ability to analyze and correct free written expression--limited, that is, in the areas of mechanics such as grammar and punctuation or higher-level values such as style. This is true despite the intensive efforts that have gone into projects like IBM's Epistle and Bell Laboratories'

Writer's Workbench (Hertz 1983b). As an example of the fundamental difficulties of this work, in one test of Epistle the program was able to parse correctly only 60% of the sentences in the text supplied to it.

Writer's Workbench is designed to provide an analysis and critique of written work submitted to it. It will produce readability data--estimates of the average length and complexity of sentences in material submitted to it--as well as word frequency counts and certain types of morphological and syntactical information. In one test, the Writer's Workbench proved to be highly critical of both Lincoln's Gettysburg Address and the opening paragraph of Dickens' *A Tale of Two Cities*. It advised both authors to use shorter, less complex sentences with fewer dependent clauses in their work! Particularly at higher levels such as stylistics, it seems that the computer is unlikely to make an extensive contribution.

Some teachers feel, however, that at a less ambitious level, these programs offer worthwhile benefits in writing courses. Computers can be programmed with relative ease to check for a very restricted number of common grammatical or punctuation errors. For example, if the word *their* is found directly followed by some form of the verb *be*, the computer can draw the user's attention to the possibility that the word *there* would be more appropriate. Similarly, the computer can check for common syntax errors such as subject/verb agreement (Lyons 1981). In terms of style, computers can be programmed to seek out some anticipated hackneyed phrases, jargon, and slang and to suggest alternative ways of phrasing them. However, the programming of more generally applicable and useful types of analysis for language-teaching purposes is much more problematic. In any event, the sophisticated programs required could not be implemented on the limited-memory microcomputers that most educational institutions are now purchasing.

CALL AND STANDARD WRITING CLASS ACTIVITIES

To prepare for a more detailed discussion, we will first examine some of the main elements of many writing curricula. One such element will be termed *grammar-oriented activities.* This type of application, which may involve either structural or notional/functional approaches, will be covered in the chapter on CALL and grammar. A second component in some writing courses is a focus on common *misspellings* of words. The computer can very easily be programmed to provide individualized practice and remediation in this area (Lyons 1981).

Another element in many writing classes is the study of *model passages* or paragraphs, followed by the creation of passages with similar functions and rhetoric. The study phase may involve computer-assisted activities that are essentially the same as those described in the chapter on reading. Frequently, of course, the reading and writing curricula are combined so that writing assignments evolve directly out of reading assignments. As far as the actual writing is concerned, model passages can be put to innovative uses as described in the 'New Possibilities' section. It should be noted that the 'model passage' approach involves students in relatively free expression within overall organizational restrictions.

A third component of many writing curricula is *guided writing.* Since many guided writing activities involve little or no free expression by the student, they are highly adaptable to computerization. *Free expression* is obviously the goal of a writing course, and the limits to the role of CALL in this respect have already been explained. However, the computer does have some worthwhile contributions to make, even in this area. These last two elements of the writing curriculum--guided writing and free expression--will now be examined in detail.

Guided Writing

The computer provides an ideal way of manipulating existing sentences and paragraphs in an effortless, dynamic manner on the video screen. It therefore brings important advantages to many types of guided writing activities.

For making students aware of paragraph organization, a common type of exercise is to provide a number of sentences which, when placed in the correct order, form a well-structured paragraph. The computer screen provides a better way of presenting *scrambled paragraph* exercises, since after each choice the computer can immediately reorder the paragraph. Students can thus experiment with a whole range of different sequences, observing their appearance and gaining a quicker, better appreciation for good paragraph structure. If a printer is available, the final version can be printed out to serve as a model.

A similar type of activity at a higher level can focus on dividing written work into logical paragraphs. The student is presented with an *undivided passage* consisting of several paragraphs on the screen that have been run together, with no indication of where the paragraphs began and ended. (The limitations of the video screen must be borne in mind here, although it is quite possible to work with a longer text by allowing the student to scroll backward and forward through the document, using the screen as a movable 'window.') The task is to indicate where paragraph divisions should be made. Once again, the paragraph divisions chosen are immediately displayed on the screen, so that students can experiment and change their minds as they gain a 'feel' for the structure of the passage.

Although these types of exercises are very worthwhile in their own right, the transfer to students' everyday writing assignments is even more effective if those assignments are done on the word processor (see below). In this case, the teacher can assess a student's own work for the logic of its paragraph divisions, and even if major structural changes such as rearranging the order of paragraphs are required, this can be painlessly done by the student with just a few keystrokes on the computer.

At a more elementary level, *scrambled sentence* activities can be much improved by presentation on the video screen. The computer can display the words of the sentence in a randomly generated incorrect order, and the student's task is to rearrange them to produce a meaningful sentence. If desired, the student can be asked to type each word, but the process can be greatly speeded up by assigning a number to each word. As the student types each number, the computer places that word next in the sentence. Interest and context can be added to these activities by accumulating the correctly ordered sentences into a paragraph at the top of the screen, with each new set of jumbled words appearing at the bottom. If a touch-sensitive screen or light pen is available, the selection of words or sentences in all these 'scrambling' activities can be made even faster and more convenient.

Free Expression

Proper planning of a writing assignment is an important preliminary step often partially or entirely neglected by students. The computer can help make this a more rewarding and systematic process. In essence, the computer is programmed to carry on a simple dialog with the student. First, students are asked what they plan to write about and why. They type either complete sentence or note-form answers into the computer. The computer asks for a succinct statement of their main theme, and tells the students to type in any subthemes they want to deal with. It then presents each theme or subtheme in turn, asking them for a brief note on any personal experiences, anecdotes, hard evidence, etc., that they may wish to introduce. Finally, it presents the students with the detailed outline that it has helped them to plan and organize. If a printer is available, this outline can be printed out for reference purposes.

It should be noted that the computer is not analyzing the students' responses in any sense or making comments on content and style. It simply helps to ensure that students consider a full range of options in a systematic manner and encourages them to develop their own mental powers.

Similar techniques can be used at the completion of an assignment before the work is submitted to the teacher. Many written assignments are unfortunately sprinkled with common errors that could easily have been detected if students were accustomed to proofreading and editing their own work. In this case, the computer can be used as a means of reminding students to check through their written assignments in an organized fashion before handing them in. This could be accomplished by having the computer print out an individualized checklist for each student. Provision would be made for teachers to add to the list of common errors mistakes that individual students were particularly prone to make. Using their computerized list, students would proofread for errors and check off the items on the list before handing both list and edited assignment to the teacher. As individual students eliminated one source of error from their writing, the problem would be deleted from their checklists.

NEW POSSIBILITIES IN THE WRITING CLASS

In terms of innovations, the major immediate contribution of the computer to writing classes will undoubtedly be *word processing*. A word processor for a microcomputer is simply a program that permits the user to permanently store, edit, retrieve, and print out anything from a single word to a book-length manuscript. Of course, these advantages are not limited to students and classrooms, and some of the labor-saving prospects for teachers are described in the chapter on testing. (This manuscript is being typed using a word processor program on an Apple computer, and the author finds it difficult to remember the dark ages when he used to perform similar tasks with only his trusty typewriter.)

The computer as word processor removes many of the obstacles facing the writing teacher. Consider the problems involved in correcting students' work. First, most of the spelling mistakes may well be due to simple carelessness and yet require valuable teacher time and attention to correct. However, along with most word processors it is possible to buy *spelling checker* programs, so that students can be made responsible for using them to find and correct spelling mistakes before handing their work to the teacher.

Next, consider the question of student response when corrected assignments are returned to the class. Teachers are all too aware that if students are simply told to review their mistakes, without being required to make any active response, many will learn little or nothing from the teacher's painstaking corrections and suggestions. In any case, the corrected page, with its notations in colored pencil, is frequently an embarrassment to the student rather than an accomplishment to be proud of. The alternative is to require an active response such as rewriting sentences in which errors were made or rewriting the entire assignment.

However, there are serious objections to both these courses of action. Most students understandably resent having to rewrite sentences that were entirely correct except for one small error. Worse still, their rewrites frequently contain new errors in place of the old. In sum, the entire process after the original version has been submitted to the teacher tends to be a demotivating experience with little learning potential for any except the most conscientious of students.

This state of affairs is transformed when assignments are stored through the use of a word processor. The teacher makes corrections on a clear, printed copy. Extensive corrections can be made, since students will be able to implement them quickly and easily. Major changes--for instance, more logical paragraph divisions or even changing the order of paragraphs--can be made equally rapidly. Nothing that was originally correct need ever be touched again. Finally, when all the changes have been made, students can print out a 'perfect' version for themselves and their teachers. The goal of each assignment thus becomes natural and intrinsically motivating: the production of the final copy.

The positive effect of technology as simple as the typewriter on student attitudes and achievement has long been recognized. Using computers in teaching young children to write appears to be having similarly beneficial effects; it also exerts a crossover influence on their reading abilities (Euchner 1982). There are very simple word-processing programs, developed for use with young children, that should be easily mastered even by the beginning-level ESL student. For more advanced students, there is a wide range of sophisticated word-processing programs. Some are accompanied by powerful utility programs that will perform spelling checks or word frequency counts. In general, the more power offered by the word processor, the more complex it is to learn and operate. It should not be difficult to find a word-processing program that is ideal for your purposes and students.

The computer also has a worthwhile contribution to make in some specific types of writing practice activities. As will be mentioned in the chapter on testing, the computer lends itself easily to the cloze technique (Hall 1980). In the basic cloze exercise, words are deleted from a text passage at fixed, regular intervals. Thus, every seventh word might be deleted, regardless of its nature. For teaching purposes, however, a *focused cloze* exercise might be more useful. In this case, the exercise could focus attention on a specific language point by deleting only words relating to that topic.

Again, the computer is an ideal display medium for this type of exercise. For example, a passage could be shown on the screen with all the conjunctions or logical connectors deleted. Students would be asked to fill in each blank with an acceptable expression. In the frequent cases where more than one expression is possible, students' attention would be drawn to the acceptable alternatives. This format could easily be programmed to permit teachers to enter and edit their own exercises.

A related type of activity involves students in the *reconstruction* of an entire paragraph or passage. The text is provided for them to study for a short time at the start, and each letter is then replaced by an asterisk on the screen. Students must now begin to reconstruct the original text by typing in a word they think occurred in the passage. If correct, the computer inserts the word everywhere it occurs in the text (Davies and Higgins 1982). In the fascinating process of building up the passage word by word, students learn a great deal about the semantics and structure of sentences and paragraphs. Grammar and spelling must be exactly right if each word they type in is to be accepted and inserted in the text. As with cloze exercises, it is relatively simple to design such programs to permit teachers to type in their own paragraphs and passages for student use.

These are some of the main possibilities that computers offer in the ESL/EFL writing curriculum. Even with the maximum computer involvement, their role would appear to be limited, though worthwhile. The evidence suggests that a fruitful blend of man and machine is possible in the writing class. Computerized analysis and improvement of written work is an area of considerable interest at present, and a number of other projects involving computers are under way (Lawler 1982) in the area of English composition. However, they seem unlikely to lead to any large expansion in the role of the computer, at least in the near future.

Chapter 6: Listening

POTENTIAL AND LIMITATIONS

In the area of listening skills, it is necessary to reverse our usual order and discuss the limitations inherent in computerization before making an accurate assessment of the potential contribution of CALL. In the case of reading and writing, basic computer systems are quite capable of delivering many of the types of activities we have discussed. For listening activities, however, the basic systems alone are generally insufficient.

The least expensive way of adding speech capability to a microcomputer system is the obvious one of providing a separate, manually controlled cassette player. Tape cassettes would be provided along with the usual computer programs. In such a system, the program would first display instructions on the computer screen, telling students which part of the tape they must play to begin the lesson. After listening to the passage on the cassette, students would then answer questions by interacting with computer keyboard and screen. Confirmation of answers, hints, messages, and all branching actions could only be provided by the computer. The tape would necessarily be limited to providing the listening materials. For example, in the course of many activities, it might be desirable for students to listen again to a specific small segment of the recorded material. With this basic hardware, and the cassette player under manual control, students would have to do the 'branching' themselves in order to locate the appropriate segment. In short, while manual operation of the player might be workable in some activities, it would generally be a clumsy and uncertain method.

The situation can be slightly improved by the addition to the computer of an inexpensive remote controller by which the computer program would take over cassette operation. Unfortunately, stopping and starting with such devices can be inexact--sometimes the starting point of the desired segment is not precisely located. Even worse, errors may arise whereby the controller misses a stopping signal on the tape and continues on to the next stop signal. From this point on, the tape will remain out of synchronization with the computer program.

Much greater convenience and precision can be achieved with a random access audio device. In one model, the listening passages are recorded on a large floppy diskette and rapid, exact access can be obtained to any speech segment on the disk. Feedback and branching are now no longer limited to the computer screen. Spoken responses, hints, and instructions can be selectively played back to students, depending on their answers, from the audio unit. Unfortunately, these devices are often more expensive than the microcomputers or terminals to which they are attached. Alternatively, the use of a videodisc player under computer control could provide many of the same advantages together with the capacity for full accompanying visual materials. Videotape recorders can also provide visual and audio materials under program control. While quite effective, they suffer from slowness of operation and lack of precision, especially when compared with videodiscs.

In summary, the potential of CALL in the area of listening skills depends very much on the type of hardware available to the teacher. At the low end of the scale, the manually controlled cassette and computer combination offers some significant advantages over the classroom situation in terms of self-pacing, individualization, and interaction with immediate feedback on errors. On the other hand, more expensive hardware such as random-access audio devices, and particularly videodisc systems, have the potential to make a much greater impact and may become affordable in the very near future.

It would be a disservice to leave this discussion without saying a few words about the often-cited comparison between CALL and the language laboratory. Listening skills have often been relatively neglected in the lab context, with speaking receiving a much greater emphasis. We will return to this point later in the chapter on speaking. Both areas have suffered until recently from a dearth of interesting and imaginative commercial materials, although the excellent taped components available with courses such as *Kernel Lessons* (O'Neill et al. 1971) have shown something of the true potential of the lab. However, a convincing case can be made that listening comprehension is an area in which the traditional language lab can play a more valid role than in the development of speaking skills.

Even with well-conceived listening materials, the lab suffers from one crucial disadvantage: its lack of interactivity. Immediate feedback on inaccurate comprehension, hints on what to listen for, transcriptions to show the contractions and reductions in speech--all these have generally been absent in the lab. However, they can all be provided as necessary via the computer screen. The computer is not likely to 'go the way of the language laboratory'; rather, just one of its functions will be to work with the tape recorder to enhance the role of the lab in the area of listening skill development.

CALL AND STANDARD LISTENING ACTIVITIES

In skill-building exercises aimed at developing the ability to *discriminate* important speech features, CALL has a wide variety of applications. This type of exercise includes the recognition of differences between pairs such as *p/b, can/can't* and *sixty/sixteen* either in isolation or in the normal stream of speech. Students vary widely in their ability to make these discriminations and in their need for practice. Using taped materials combined with questions, hints, and answers on the video screen, computers can offer a high level of individualization for more effective, student-centered instruction.

CALL offers similar advantages in more *extended listening* activities. Consider a story or lecture presented for listening comprehension via a random access audio recorder under computer control. The passage could be stopped at appropriate points to check on students' comprehension of general points and important details, and to ask them to predict what is likely to be coming next. Should they be unclear on such points, they can automatically be routed back to listen to the section containing the information they missed, before continuing with the passage.

Note-taking activities can similarly be enhanced through CALL with random access audio equipment. At the end of a spoken passage, for example, students can use their notes to help them complete a partial outline displayed on the screen. At each step, gaps in their notes or misunderstandings can be handled by a computer-managed return to the appropriate section of the listening passage. If they have further trouble, a variety of hints and suggestions can be provided, possibly including, as a last resort, a transcription of that listening segment.

NEW POSSIBILITIES IN LISTENING ACTIVITIES

In general terms, the main new contribution of computer-assisted learning in the area of listening is likely to be a change in the role of the learner. CALL makes it possible to turn over much control and responsibility to the student while providing very attractive course materials with the desired curricular requirements built in. It should be stressed again, however, that the realization of this potential in listening activities will be more highly dependent on hardware availability than in other skill areas. For most basic activities, the computer system would need to be supplemented with at least a cassette recorder and headset, and some of the most worthwhile activities would require further hardware.

One attractive possibility, requiring only the basic equipment, is a series of *listening laboratory* materials. This would comprise a set of graded listening passages recorded on audio cassettes, with a good selection of passages at each level. Given such a choice, students would be likely to find passages at each level on topics that were genuinely interesting to them. There would be computer programs to accompany each taped passage. Students would first listen to a passage and then work with a range of different types of computer-based activities. One of the main advantages of the computer medium here would be its great flexibility. In a workbook approach, students check their work by looking at the correct answers. If they are wrong, there is obviously no further possibility of working toward the correct answer.

With the computer, however, the correct answer need not be revealed when students' answers are first evaluated. If the answer is wrong, the computer can provide students with a wide range of hints, prompts, and partial answers. CALL programs can also provide various helpful materials on points of rhetoric, culture, and the like. Using these tools at their discretion, students can listen to sections of the passage again and continue to try to work out the answers for themselves.

Two further activities, feasible even with only the basic hardware, are modified versions of the *cloze* and *reconstruction* formats outlined in the chapter on reading. In these adaptations, both activities are based on listening passages recorded on cassette tape with accompanying computer programs. Students begin by listening to the passage once. In the cloze approach, they must then complete the blanks in the same passage, now displayed on the computer screen. In the reconstruction exercise, the passage is displayed on the computer screen with underscores replacing the letters of all the words. Students try to reproduce the entire passage from memory by typing in remembered words one at a time. If a word is correct, the computer inserts it in all the places where it occurs in the passage. When students have done what they can from memory, they may listen to the passage again for additional help.

Listening-oriented cloze and reconstruction activities of this type can easily be prepared by the teacher, provided that the appropriate 'utility' programs are available. In this case, the utility program would enable teachers to type in their cloze or reconstruction materials at the keyboard. These would then be stored in diskette or other form for student use. No knowledge of computer programming would be needed in this process. The cassette recordings would be prepared in the usual way. The exercises could thus be focused on language and topics drawn directly from current class materials. The activities could also be given a competitive or game-like atmosphere by introducing points added or lost for correct or incorrect answers, bonus points for several consecutive right answers, and so on.

It is instructive to compare these activities with a traditional pen-and-paper or workbook dictation exercise. Similar as the objectives are, the computer-based activities have very compelling advantages in terms of learning opportunities, motivating power, and sheer enjoyability along the lines described elsewhere in this section.

Of all computer-assisted listening activities, however, those with the greatest potential impact will require an additional item of hardware: a computer-controlled random access videodisc player. There are two main types of videodisc player currently available: *laservision* and *CED*. The CED technology, popularized by RCA, has been unsuitable for educational use because it lacks a random access capability. (RCA has begun demonstrating a prototype CED player with this feature, however.) The laservision format is inherently capable of random access and has been increasingly used for educational purposes. In its most common current form, the laservision player can provide rapid access to any of the 54,000 picture frames on one side of the videodisc. An individual frame can be shown on the screen, alone or with superimposed computer displays, turned on or off, or used as the start of a movie sequence that can be 'frozen' at any of its frames. While a film sequence is running, either or both of two hi-fi audio tracks on the disc can also be played.

In short, the videodisc and player can provide a full visual context as well as the usual audio material, and they can operate rapidly and accurately under computer or manual control. This capability has tremendous implications for the design of complete language courses, and we will return to this point in a later chapter. For the moment, let us examine the potential for listening skill development.

The presentation of the visual context along with the spoken material has a number of important effects. Perhaps the most obvious and dramatic is the power to involve students and hold their attention. Well-produced disc materials are generally extremely enjoyable to use without sacrificing any instructional potential. Few traditional materials have this advantage, and its value should not be underestimated.

A second important feature is the presentation, along with the audio material, of the full normal range of extralinguistic clues to meaning. This permits students to grasp or confirm the meanings and structures of spoken language elements to a much greater extent than would audio material without a visual channel. Videodisc-based CALL can thus provide opportunities that may maximize the potential for language acquisition.

This form of CALL may be of particular interest to theorists who advocate extensive exposure to spoken language before students begin active language production. In practical terms, it certainly makes possible the use of relatively advanced material by lower-level students. Such students can use the visual clues and view the difficult sections repeatedly until the material is understood. They can also be provided with various hints and other types of help from the computer if they need assistance. Their motivation in the face of material that might otherwise be frustratingly difficult is maintained at a high pitch through the attractiveness of well-designed disc programs.

Through the use of computer-controlled videodiscs, a wide range of listening activities can be performed, including all those described previously in this chapter as audio-only activities, but now enhanced with full visual context. For example, after they have viewed a section on the disc, students' comprehension of important detail could be checked via the screen. Whenever a mistake is made, the specific speech segment that the student misunderstood can be replayed rapidly and precisely, with accompanying video.

In addition, a full range of 'help' materials could be provided by the computer for student use when needed. These would probably include assistance with standard points of vocabulary, speech features, and the like, but some new items would become possible with the visual medium. In particular, cultural aspects such as table manners and distance between speakers could be very effectively addressed. In fact, a wide range of diverse aspects of language and culture could be covered with the same film material through different computer programs accessing a single disc in completely separate sequences in order to focus on different points.

Finally, let us return to a computer system with a cassette recorder under computer control in order to discuss one type of activity in which the computer acts as game master. In these *deduction* activities, the student 'listens in' to various conversations or conversational fragments. In one scenario, these are 'the results of a tap on a suspect's telephone,' and students play the role of detective, trying to make deductions about crimes committed, identities of the criminals, value of the loot obtained, etc. Students are given the first question to be answered, and short conversations or fragments are played one at a time. After each is presented, students are asked whether they are ready to make the first deduction. Each new conversation makes the problem easier, but students gain fewer points for solving it. Whenever the first question is answered, the remaining conversational clues for that point are skipped, the second problem is explained, and the series of clues for that problem begins.

This type of activity again makes use of the capability of the computer to judge students' answers without necessarily revealing the correct solution, and to provide very flexible types of responses depending on those answers. However, this deduction activity illustrates a point that is true of many 'listening' exercises: while they can be worked on separately by individual students, they can also be used with groups of students to stimulate a whole range of interactions. Discussion, planning, argument, and persuasion are all involved in group work on deduction problems. Listening and speaking activities are combined in a purposeful and authentic context.

Similar effects can be achieved when many activities originally planned for individual work are implemented as pair or group tasks. In the case of deduction, the crossover need not be limited to listening/speaking. As the concluding phase, each group member might be asked to summarize the steps of the deduction in writing. Even more stimulating written accounts could be anticipated if each member were also asked to describe how the other students contributed (positively and negatively!) to the correct solution. As so often is the case in CALL, the potential for valuable language-learning activities is impressive.

Chapter 7: Speaking

POTENTIAL AND LIMITATIONS

Of the four traditional skill areas, speaking is the one in which CALL has the least potential as far as standard class activities are concerned. Even if the computer could be programmed to conduct spoken practice and to carry on free conversation with students, there would be strong objections to its use in terms of language as a social phenomenon involving quintessentially human reactions and interplay. However, quite apart from the social and philosophical questions, there are simple technical factors that limit the role of the computer.

To illustrate the obstacles, consider one of the lowest-level speaking activities in the classroom: the mechanical drill. In general, when students are called upon in this type of drill, there is one clearly defined 'correct' response that they are expected to produce. Despite this, the teacher judges students' answers in a surprisingly complex way, making such decisions as when to ignore or correct errors, what style of correction to provide, whether to repeat the item or provide a similar item, and how to deal with an unexpected but correct answer that is irrelevant to the point of the drill. All this is occurring at every step of what appears to be a very mechanical, predictable spoken drill!

Now this type of analysis--comparison with anticipated and unanticipated wrong answers, followed by branching--is one of the strengths of the computer. As written exercises, mechanical drills can be handled with ease. Unfortunately, in the medium of speech, even the first step in the chain is a major obstacle--for all practical purposes, computers cannot perform the necessary analysis of any extended utterances.

It is here that the limits of CALL in standard speaking activities are grounded. For instance, it is true that, with additional hardware, the computer can record and play back speech in very convenient ways as described in the next section. Where speaking skills are the main focus of an activity, however, sophisticated computer-controlled hardware generally has few--if any--advantages over the simple cassette recorder. Because the computer lacks the ability to analyze students' responses, its tremendous power to interact with students and individualize their learning materials cannot be called into play.

On the positive side, one area where a certain amount of simple speech analysis can be performed is in the pronunciation of phonemes and single words. Computer-controlled hardware can make a small but worthwhile contribution here, as described in more detail in the last section of this chapter.

There are two other areas in which CALL approaches have the potential to make a significant impact on speaking skills. First, where speech is just one component of materials whose major emphasis is on other language areas, computer-controlled playback of spoken material can play a valid and effective role. More important, CALL activities can serve to stimulate language use by providing enjoyable, absorbing contexts for pair and group work and conversation. This approach is all the more attractive in that it requires only the most basic computer systems for its implementation. These applications will be described in detail in the following sections.

CALL AND STANDARD SPEAKING ACTIVITIES

With regard to speaking activities, older forms of educational technology such as the language laboratory tape recorder have fulfilied two main purposes: providing speech models and recording students' voices. The place of the computer in this scheme of things will now be assessed in detail.

Providing Speech Models

In terms of familiar language-learning practices, the most obvious use of technology has been in the provision of speech models. The only significant contribution in this regard has come from the open reel or cassette tape recorder, and it is against these that computer-assisted techniques must first be measured. As noted previously, it is important when assessing the place of CALL in speaking skills to distinguish between situations in which speaking is the main focus of an activity and those in which speech is a relatively minor component. We will deal with these in turn in this section.

Wherever the development of speaking skills is the main point of an activity, computer systems compare very unfavorably with the simple cassette recorder, because they achieve little or nothing extra for a large additional expense. If a drill is being presented, for example, the computer could be used to control a cassette recorder. However, since the computer is unable to evaluate students' responses in any way, none of the power of CALL can be utilized, and the exercise can only follow the prescribed sequence on the tape. In such circumstances, why use the computer at all? These comments apply with still greater force to the more sophisticated and expensive systems for computer-controlled speech recording and generation.

For these purposes, the computer appears to be much less attractive than two other recent additions to our technological bag of tricks: videotape and videodisc players. Used on their own (since computer control adds no benefits in this case), either of these visual media represents a considerable advance over audio tape. Particularly where activities involving dialogs are concerned, a full visual context offers students an opportunity to add authentic extralinguistic features to their learning and role playing, and it also greatly enhances the attractiveness of the task.

It is only where speech models are a minor component of other activities that the introduction of the computer becomes worthwhile. To illustrate this point, consider a CALL exercise in which new vocabulary is being introduced and used primarily with reading or writing materials. With new vocabulary, it is often desirable for the student to hear the correct pronunciation of the expressions before meeting them extensively in print. At the simplest level, the teacher could introduce and pronounce key vocabulary items in a general class session before moving into the computer-based activities.

To permit individualization of the vocabulary introduction, it would be possible to provide a manually operated cassette recorder with each computer, but greater convenience in locating and presenting the individual expressions would be obtained with a relatively inexpensive computer-controlled recorder. Of course, additional power and flexibility would be gained with more sophisticated computer-controlled speech sources such as random access recorders or digitizers. Vocabulary could be presented in random order for the purpose of review, and remedial work on difficult items could be accompanied by spoken materials. Whether the benefits justify the much greater expense would depend on the importance of the applications; in general this seems doubtful if speaking activities alone are considered.

Recording Speech

It is possible to obtain inexpensive digitizer cards for some microcomputers that will record students' speech temporarily and play it back. More permanent recording (for playback at any time) can be achieved with random access audio recorders or more sophisticated digitizers. However, these devices generally suffer in at least two ways when compared with the familiar cassette recorder. First, they are considerably more expensive, although the rapid downward movement in the cost of all computer technology may reverse this state of affairs in the future. Second, although some of these devices are capable of very high fidelity recording and reproduction of speech, in practice their sound quality is sometimes deliberately degraded to make it possible to record a large quantity of spoken material.

For most applications involving the recording and playback of students' spoken responses, therefore, it is difficult to make a convincing case for the expensive computer-controlled hardware that is required. Much better arguments can be advanced for purchasing the additional hardware for listening skills work. Once available, of course, it could also be used for recording applications.

NEW POSSIBILITIES IN SPEAKING ACTIVITIES

One potential contribution that computers can make is in assisting students to achieve better *pronunciation* of the target language. One type of system comprises the computer and a microphone and digitizer under its control. Ideally, the standard pronunciations for the expressions have already been recorded in the digitizer. Working from speech models supplied by any of the means previously discussed, e.g., cassette tape, students try to pronounce expressions correctly when prompted in writing on the computer screen. If the students' pronunciation deviates too far from the model stored in the digitizer, they are told to try again. If necessary, students can repeatedly listen to the model. The objective is to achieve a consistently acceptable pronunciation, and the system has obvious applications for persistent second language pronunciation problems associated with particular native language backgrounds.

Unfortunately, affordable systems of this nature are still in a developmental stage. With some systems, for example, the digitizer is highly voice dependent. In other words, the digitizer attaches considerable weight to the personal characteristics of an individual's voice as well as to linguistically significant features. Thus, it may be difficult or impossible for the teacher to record standard pronunciations for use by students. Instead, each student must 'train' the digitizer with his or her own best pronunciation, under teacher supervision, before beginning the practice. At best, this provides an opportunity for review and practice, but the fact that the students' own pronunciation is used as an objective is clearly a very serious drawback.

A second limitation with many systems is that each speech act must be short--often less than two seconds in duration. This rules out any material longer than a few words. However, organizations such as Scott are working toward the much more satisfactory goal of a voice-independent digitizer capable of handling longer stretches of language.

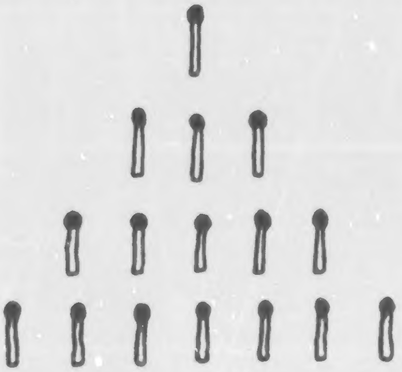
In terms of immediate, practical impact, the computer can make its greatest contribution to speaking skills in the role of *conversation piece*. In theory, this will work best when we have a range of CALL materials designed specifically for the purpose of stimulating and guiding conversational interactions among ESL students. In practice, however, virtually *any* software can provide a context for valuable conversation, provided it meets two simple criteria: it must be interesting to students, and it must be comprehensible to them in linguistic and cultural terms.

In principle, then, virtually all CALL courseware designed for use by individuals for other skill areas can also be used for speaking practice by assigning students to work in pairs or larger groups. When used by pairs of students, for example, grammar drill-and-practice materials often produce animated discussion concerning possible answers and mistakes. Even more surprisingly, experience has shown that students have a strong tendency to use English when working together at the computer, even when they share a native language.

Simulations work extremely well as conversation starters with groups of students and function as collaborative materials just as they did when used by individuals. Suppose that students are working with the Oregon Trail simulation, making daily decisions that may lead to their reaching the promised land or leave them dying by the wayside from attacks by hostile natives or lack of food and water. With three or four students around the computer, it is impossible for all to reach the keyboard, so that one student generally does most of the keying-in. In addition to the functions of persuasion and argument, the others must use language to instruct and direct the student operating the keyboard.

The result is fascinating and valuable conversational practice. Since the students are essentially cooperating to battle against the computer, their interactions and language are highly authentic. The smooth, automatic operation of a computer-based simulation assists them to suspend their awareness of the classroom situation and indulge in realistic, purposeful language use. It is difficult to achieve this degree of authenticity consistently with conversation activities in the traditional classroom. Many types of fantasy adventures and games have similar power to enthrall students and involve them in animated conversation.

In addition to these relatively undirected speaking activities, it is possible to focus more precisely on *specific language functions*. Suppose that the class has been working with functions such as expressing possibility, probability, and prediction. This focus could be maintained by having them work in pairs or groups on the match game. The game board, as shown on the computer screen, consists of four rows containing one, three, five, and seven matches, respectively.



The student group and the computer take turns removing anything from one match to an entire row of matches each time. The object is to leave the last match for the computer to pick up. This is an absorbing game of strategy, where students must continually ask each other 'What if ...' questions and suggest what the computer will probably do in response to their moves.

Another more focused conversational activity is *simulated conversation*. In this case, the 'conversation' is in fact carried out not in speech but in writing as a dialog with the computer. Within a highly restricted field of interest, students can conduct typed conversations with the computer in a 'free' manner. The first example of this was a program called ELIZA (Weizenbaum 1976), which was developed as part of research on artificial intelligence.

Much of this work was stimulated by the insights of Alan Turing, who in a celebrated paper (Turing 1950) proposed a method of testing the question, Can machines think? In the Turing test, as this is now known, there are a human interrogator and two responders--one human and one computer. Interrogator and responders are linked only by keyboards and screens. The test of the machine's intelligence--its ability to think--is simple: can the interrogator, by questioning either or both responders, determine which is the human and which the computer? Hence the attempt to develop computer programs that can converse in a convincingly 'human' way.

In a simulated conversation with the ELIZA program, the topic of conversation is restricted to one of the 'scripts' that are provided. Perhaps the most famous of these is the psychoanalyst script, in which the computer behaves as a non-directive counselor. However, there is no reason in principle that similar programs with 'scripts' specifically aimed at language learning could not be developed. For example, a topic such as 'your family' could be selected (Underwood 1982). Students could then carry on relatively free dialogs with the computer, initiating and controlling the conversation, stopping and starting wherever they wished, and asking for help with the language if desired. The computer could be programmed to call attention to important errors in the students' input as well as to respond conversationally. Of course, it must be recognized that this type of 'conversation' has a limited role to play. It may provide useful preliminary practice with features of conversational language such as grammar, vocabulary, and level of formality.

The computer can also provide a much more convenient medium for some traditional speaking activities. As an example, consider the *strip story*. In its standard form, this involves dividing the class into two or more teams. Each team is given a different short 'story' cut up into strips so that each team member receives one sentence. Students have a short time to memorize their sentences, after which the strips are destroyed or returned to the teacher. The members of a team must now cooperate to assemble their sentences in the correct order, without writing anything down. Finally, when ready, the teams write their complete stories on the blackboard. Points are awarded for accuracy and speed.

Strip stories work well in the traditional classroom to stimulate spoken interaction and cooperation among students. However, there are frequent practical problems. For instance, with a class of fifteen, the teacher might decide to prepare three strip stories of five sentences each. Inevitably, when the class begins, two students are found to be absent! The teacher now needs two stories with six and seven sentences, or two more with four sentences. Carrying the necessary multiple number of sets of cut-up strips to cover all the possibilities can be awkward.

However, the problem can be solved by storing the teacher's collection of stories in the computer, indexed by number of sentences as well as title. When a story is used in class, the computer will present each sentence, in random order, on the screen for a short time. After the discussion period, the students can type in their story, using the computer as word processor. Their version, together with the original, can be printed out in multiple copies for the team members to study. This is a minor example of an important role for the computer: that of teacher's aide. We will return to this theme in much more depth in the last chapter.

Chapter 8: Grammar

POTENTIAL AND LIMITATIONS

In the minds of many teachers who are unfamiliar with computer-assisted language learning, CALL is synonymous with grammar drills. This is not surprising, since much of the older software was grammar oriented, and this is still true of many recent materials. This rather unbalanced state of affairs is unlikely to persist much longer as the potential of CALL in other language skill areas and aspects becomes apparent. However, the close association of CALL and grammar in many minds is undeniable at present and has led to some interesting--and at times heated--debate.

One of the results has been a crossfire of criticism of CALL grammar materials from both advocates and opponents of computer-aided methods. Those antagonistic to the computer have held up this type of material as representing the whole field of CALL, a viewpoint that had some validity until quite recently, but which is becoming increasingly untenable. Some proponents of CALL in general have also strongly criticized materials dealing with grammar.

Unfortunately, both types of critics have tended to cloud the issues by confusing the medium with its content. After all, if one is teaching ESL at the beginning through intermediate levels, virtually all the available courses and textbooks have a high content of 'drill' activities. The drills in recent courses, however, are very different from those of fifteen years ago. Far more attention is now paid to meaningful and communicative drills with realistic situations and contexts. Some teachers and theoreticians may nevertheless wish to abandon drills in general, both in the classroom and on the computer. However, it is important for us to recognize when this is the true basis for criticism of CALL materials, since it does not then amount to a rejection of the computer medium itself.

Even with those who accept the validity of drill, there has been justified criticism of some of the existing CALL grammar materials. A sizable number of them reveal a strict audiolingual method legacy, and they are frequently mechanical, uncontextualized exercises that display little imagination and few features of interest. Such materials may deserve the criticism they attract, but unfortunately the negative reactions have often been generalized to apply to all CALL grammar programs. In fact, there are worthwhile materials to be found both on large computer systems and on microcomputers. These materials cover both structural and notional/functional approaches to grammar.

In summary, those teachers who utilize modern forms of drill in their classes will find equally up-to-date grammar drill-and-practice materials becoming increasingly available on the computer. Computers have the potential to provide tireless, patient practice that can be automatically individualized according to students' problems and capabilities. As a highly flexible tool, the computer can provide general class assignments in place of homework, remedial opportunities for slower students, make-up assignments after absences from class, and review opportunities before tests. In these roles, it is not intended as a substitute for the spoken word in the classroom. Rather, it can provide a high level of written follow-up to such activities.

Some advocates of new CALL grammar approaches do not reject the drill-and-practice concept. What they find objectionable is the dry, unimaginative, cumbersome nature of some of the existing exercise material, with little attention paid to providing interesting or realistic contexts. They contend that instructional practice activities can have a high drill content and yet be innovative and exciting to use (Rowe 1983). Other proponents of CALL materials are much more interested in collaborative types of programs. Some of the attractive and engaging possibilities for grammar-oriented activities that represent new alternatives to the drill format will be described in detail in the last two sections in this chapter. Also, for those teachers who wish to provide students with access to extensive information and practice on grammatical concepts, the computer can provide a very efficient out-of-class tutorial medium that permits work in class to focus on higher-level language activities and use.

In the future, then, some forms of grammar-oriented CALL materials will probably have a worthwhile role to play in many curricula. In general, they will probably not be involved in the initial presentation and practice of grammatical material, but rather in the follow-up role outlined above. Within the field of CALL, it seems likely that there will be a considerable readjustment in the relative importance of grammar-oriented materials as the potential of computer-assisted learning in the areas of reading, writing, and listening begins to be realized.

CALL AND STANDARD GRAMMAR ACTIVITIES

As pointed out above, many currently available ESL courses at the beginning and intermediate levels contain a large proportion of drill activities. Some of these courses attempt to provide written follow-up in the form of traditional workbooks, whereas others make little or no provision for written work. In either case, instructional CALL materials could provide enjoyable and effective written follow-up to the class activities. Various aspects of grammar could be addressed, including structural and notional/functional points. The computer-aided exercises would provide a quicker means of working through the material and would enable students to focus more closely on the main language points at issue. Immediate feedback on errors, self-pacing, and individualized attention to students' problem areas would all represent significant advantages in the computer-based practice. All the above points will be illustrated through descriptions of actual activities in the remainder of this section.

When used as follow-up to classwork on *structural grammar* points, CALL activities can immediately detect predictable errors and supply corrective information. Consider an exercise on yes/no and information questions using the simple present in the context of habitual activities. In the CALL materials, a description of someone's daily schedule appears at the top of the screen. In the bottom half of the screen, the computer presents brief question-and-answer pairs or dialogs, based on the schedule, with blanks for the student to fill in.

So far, any workbook could do the same. However, the computer's power now begins to be used. At the start, only single blanks are presented, with a mixture of the different question types. Errors are immediately detected and explained, and the student is given further chances at the item. If the student does well, the supports are progressively removed as more and more words in the following questions are blanked out. If the student has greater trouble with one of the question forms--say, the information question--then more items of this type will be presented.

A similar technique can be used in CALL activities following up on *functional* points of grammar. For example, consider an exercise in which the function of expressing personal opinion is combined with attention to comparative and superlative forms. The computer directs students to look at illustrations on various textbook pages, questioning them each time as to their personal opinion on some point. Part of their answer is also supplied, so that students need only complete the statement. They are to begin with expressions such as *in my opinion* and *I* *think that* and to supply the correct adjectival forms at the end.

The computerized activity has several advantages over the textbook. For one thing, most students tend to use just one or two familiar exponents of a function instead of trying to activate new ways of expressing it. In the CALL exercise, the computer will permit only two or three repetitions of one exponent such as *I think that* before pressing students to come up with some different expressions. It will immediately point out any problems with the comparative and superlative forms. The activity can, as always, provide a large number of items, but only for those students who appear to be having problems. Finally, a considerable amount of humor could be introduced by having the computer comment on the students' opinions.

Computerized follow-up to classwork becomes particularly attractive at more advanced levels where students are frequently handling quite lengthy clause and sentence patterns. Consider activities involving *sentence combining* to form relative clauses. Workbook-based written activities usually involve time-consuming recopying and rewriting. However, using the flexibility of the computer screen, students can move whole sentences to form relative clauses within other sentences with a few touches on the keyboard (or directly on a touch-sensitive screen if available). Possible alternatives can be tried, with an immediate chance to observe the results and change one's mind if necessary. Students are thus able to concentrate on the relevant features of the sentence instead of laboriously rewriting all of it, including phrases and clauses that are not the focus of the activity.

Materials of these types can be particularly valuable when they are aimed at points of grammar that cause *persistent difficulty* for many learners. Students can return periodically during a course to work on areas that are particularly hard for them, with the computer maintaining progress records of value to students and their teachers. Going one step further, students can be given diagnostic tests when they enter a course and then referred to the appropriate CALL materials for areas of demonstrated grammatical weakness. Work on the computer can be assigned for completion out of class to assist students in catching up to the general class level.

The computer can also provide an attractive medium for preliminary practice with *conversation* patterns. These applications have been described in detail in the chapter on speaking.

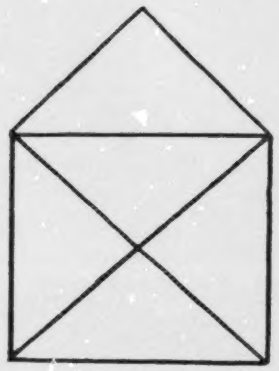
Finally, in courses where more extensive attention is paid to formal statements about grammatical structures and rules, the computer can also make a significant contribution. Students vary widely in the speed with which they can understand and apply grammatical generalizations and rules. However, teachers are understandably reluctant to take up valuable class time in lengthy explanations. For those students who require longer, more carefully structured explanations, the computer can be an effective *grammar tutor*. Optionally, these instructional types of programs can maintain useful information on progress and problem areas for the benefit of students and their teachers.

NEW POSSIBILITIES IN GRAMMAR

Once again, the activities in this forward-looking section are generally collaborative, involving a change in the role of the student from responder to initiator. One new possibility is the *ask the computer* format, in which the computer possesses an item or items of information that the student must obtain. This situation is tailor-made for a very wide range of activities focusing on question structures in English. For example, Gourmet is a program in which the students' task is to 'discover' three types of food that the computer has never tasted. In order to do this, students must use questions of the form 'Have you ever had...?' or 'Have you tried...?' In other words, they must use appropriate, well-formed questions in the present perfect. If their questions are ungrammatical or inappropriate, the computer simply says 'I beg your pardon' or 'I'm sorry, I didn't understand what you said' and politely asks them to try again. Students generally need to ask between ten and twenty such questions, using the present perfect in an entertaining way, before finding three foods new to the computer.

A similar approach can be used in the teaching of imperatives and spatial relationships through the use of the computer screen's graphics capability. A seminal program called SHRDLU with a number of important implications along these lines was developed by Winograd (1973) as part of his work on artificial intelligence. In this system, the computer maintains and interacts with a very restricted system, or 'blocks world,' made up of surfaces and colored objects such as a cube, pyramid, and box. The user 'talks' to the computer, perhaps telling it to place the pyramid on top of the red cube. The computer tries to understand the user's commands, which are given in a small subset of natural English. If the command is understood and is feasible, the computer can make the appropriate change in its knowledge of the world, which could be displayed on a video screen. If an impossible operation is requested, such as placing the cube on top of the cone, the computer recognizes this and makes no change in its 'world.'

SHRDLU was not designed with language-learning purposes in mind. However, even with a much less sophisticated approach, similar methods could be used to develop a number of different *microworlds* in which students must use commands and spatial terms to manipulate objects on the screen. For example, the student could tell the computer how to draw the following figure without lifting the 'pen' off the screen or retracing the same line twice:



In doing so, students would have to use well-formed commands embodying several different types of prepositional phrases. Logical or semantic errors would immediately show up in graphic form on the screen. These are simple examples of the *word picture* type of activity, which will be treated at a more sophisticated level below.

Another kind of relationship between student and computer can be developed in which roles are reversed and the student teaches the machine. In the familiar Animals computer game, for instance, the computer asks the student to think of an animal and then tries to guess what it is. At the start, the computer only 'knows' two animals, so it is extremely unlikely that it will be able to guess the student's choice. When the computer is stumped, it asks the student to teach it three things: the name of the new animal, the plural form of the name, and a question that will discriminate between the new animal and the closest animal known to the computer. A brief sequence might proceed as follows:

Computer:	Does it live in the water?
Student:	No.
Computer:	Is the animal you're thinking of a moose?
Student:	No.

Computer: All right, I give up.
What is the animal you're thinking of?
Student: A zebra.
Computer: Please type a question to show the difference between a moose and a zebra.
Student: Does it have stripes?
Computer: What's the correct answer for a zebra?
Student: Yes.
Computer: What's the plural of *zebra*?
Student: Zebras.
Computer: Thank you. Now I know 3 animals!
Do you want to play again?

...and so on.

The computer will use what the student teaches it in future rounds of the game. In this version, adapted for ESL purposes, the computer will sometimes use questions in the plural and sometimes in the singular. It provides absorbing practice with several points: singular/plural, WH-questions, and yes/no questions. As a follow-up to a lesson dealing with any of these points, it presents an attractive alternative or supplement to straightforward drill-and-practice. *Teach-the-computer* activities of this sort could be developed to cover other areas of language.

Another fruitful area is the *relationship* activity, in which attention is focused on different exponents of a function and their levels of formality or informality. In one variant, students are told they are in an unfamiliar city and need to find the central post office quickly in order to mail an important letter before the last collection of the day. The computer then describes the current scene, including passers-by whom the student must ask for information in order to find the post office. At each encounter, the student must choose from a range of questions at different levels of formality and informality. The passers-by will be uncommunicative or downright obstreperous if the wrong level of formality is used, and valuable time will be wasted.

In another variant, the student and computer are *partners*--for example, the student is the supervisor and the computer a member of his staff. Their 'job' might be to install several new telephones in an apartment building. Again, students must choose from a range of different levels of formality in questioning various inhabitants of the building and in giving instructions to their computer 'laborer.'

This type of simulated interaction can be further enhanced by using a computer-controlled videodisc to show students the results of their chosen language in movie sequences. One simulation of this type, based on videodisc players controlled by a microcomputer, has already been developed for learners of Spanish in the Montevidisco project (Schneider and Bennion 1983). In this exciting pioneering project, important linguistic and cultural points are combined in an absorbing simulation of a visit to a Mexican village. It can only be a matter of time before similar materials are developed for the ESL curriculum.

With grammar points that simply need to be learned, such as the past forms of irregular verbs, one method of making the work more enjoyable is to present it as a game for two or more players. The computer can act as 'host' in a game show setting, presenting items to each participant in turn. All the features of these shows can be mimicked, including bonus points for several consecutive right answers, surprise questions, and a flashing, animated scoreboard. Most students will enthusiastically spend all the time allowed them on these learning games, and their recall of items on which they originally made mistakes is surprisingly good.

Finally, let us examine some of the *word picture* activities that are possible with more sophisticated hardware. For successful implementation, many of these programs would require a computer-controlled videodisc or videotape player, although some could be implemented with simple computer graphics. In word picture activities, when students produce a meaningful and well-formed word, phrase, or sentence, they are shown visually what they have created. The provision of visual information along with the text medium will tend to enhance learning and retention.

This approach is related to the computer 'microworlds' described previously. It is also similar in concept to the 'turtle graphics' component of the Logo computer language (Papert 1980). One of the central principles behind Logo is that the process of learning can be made far easier if the results of the learners' efforts are displayed in graphic form. Another important concept is that extraneous obstacles to learning should be removed as far as possible by the use of microworlds designed for this purpose. Just as with Logo, word picture activities may be most effective with young learners of English.

We will briefly examine two more specific types of word picture activities. In the first, students work with restricted groups of words on the computer screen. For example, there may be noun phrases like *his car* and *her car* and a range of comparative expressions such as *longer*, *slightly*, and *much*. Students choose words from the group (via a numbering system, touch-sensitive screen, or light pen) to form sentences at the bottom of the screen. When a well-formed sentence is produced, an appropriate audiovisual sequence is shown from the videodisc. An example of this (although based on computer graphics, not the videodisc) is to be found on the PLATO system.

A second type of word picture activity, at a more basic level, would be suitable for much younger beginners in a second language. The students play with restricted groups of letters shown in enlarged form on the computer screen and move them about as described above. Whenever they form a word, that word is shown in simple sentence contexts on the computer screen with accompanying audiovisual material from the videodisc. This type of system may also have general applications in first language reading and writing. Its potential is considerable, since it allows the young learner to 'play' with written language, while providing immediate confirmation of accurate language use through semantically rich audiovisual channels.

Chapter 9: Other Areas of ESL

Computer-assisted learning also has significant implications for other aspects of the teaching of ESL. In many of the areas covered in this chapter, such as *study skills, cultural orientation, testing,* and *English for specific purposes,* very little software has yet been published. In other areas, notably *bilingual ESL* and *teacher's aides,* substantial materials are already on the market.

STUDY SKILLS

Computer-assisted methods have considerable potential in the area of study skills. The situation is similar to reading in that study skills are highly idiosyncratic in their acquisition and use, with wide variations in technique, speed, and ability among students at the 'same' level of English proficiency. These circumstances call for an individualized learning approach of the type computers can effectively supply. Also, since most study skills involve students in producing written responses, this is an area in which basic computer systems are quite adequate.

Note making from a reading passage is an activity that lends itself particularly well to computerization. If sufficient computer time is available, students can enter their notes directly into the word processor as they are reading, returning at the end of the passage to organize them into a logical final form. A more sophisticated note-making activity might present the reading passage on the computer screen, enabling the students to select words, phrases, or sentences with just a few keystrokes as part of their 'notes.' At the end of the passage, the notes could be directly printed out or returned to the screen first for polishing.

Skill in *note taking* from lectures could be developed using video-based materials in a similar manner to other listening skills materials. In the course of typing in answers to questions based on the listening material, students would also be building up a well-rounded set of notes in word-processing form that they could then utilize in other written activities.

Another set of study skills that could be handled very effectively by CALL techniques would be *the efficient use of textbooks*. This would cover topics such as location and function of different parts of textbooks (index, appendices, etc.) and the use of appropriate reading styles such as skimming and scanning. All exercise materials would be presented on the computer, with reference to a textbook in the students' hands. The CALL programs would contain a simple authoring system so that teachers could enter questions and answers based on actual textbooks available in class and relevant to the students' interests. Where possible, a text would be used from a course the students were currently taking. In this way, the lack of realism involved in using their ESL textbook as the study text could be avoided.

CULTURAL ORIENTATION

In many of its aspects, the contrast between American cultural values and practices and the students' own culture can be a fruitful, engaging, and humorous source of traditional classroom activity and discussion. However, the role of the computer as a private, emotionally neutral learning medium can be of potential value in dealing with areas where students' cultural habits or practices are in embarrassing and awkward conflict with their new environment.

In certain areas of the world, for example, water is a precious substance not to be wasted by overly frequent bathing or showering. Unfortunately, transfer of this level of personal cleanliness to the United States can create a very negative impression. In some cultures, public rebukes are never given, and students may respond to mild criticism with smiles or laughter that result from their surprise and uncertainty toward what they perceive as extreme rudeness. Again, this type of reaction can easily be misinterpreted in the American milieu. Attempts to explain or discuss such topics in class, particularly when students are relatively new to the country and have the greatest need to understand them, often end in embarrassment and failure to communicate.

Topics like these could be presented in a less threatening and less awkward manner through *cultural simulator* programs. With the most basic computer hardware, students are placed in situations described in text passages on the screen. As in all simulations, they are given a choice of several actions and are then shown the consequences of their behavior. Explanatory notes can be provided, and students can be routed back to test other options. With a computer-controlled videotape or videodisc player, much more powerful presentations, involving a whole range of subtle cultural phenomena, are possible.

As mentioned elsewhere, a prototype of this approach called Montevidisco (Schneider and Bennion 1983) has already been produced to simulate a visit to a Mexican village for American learners of Spanish. The use of the visual medium also helps to overcome the problem of using such cultural materials with limited English speakers. Working at their own pace with the helpful context provided by the video, students find it possible to comprehend relatively difficult materials.

TESTING

Computer-assisted techniques can contribute in at least three important ways to the process of language testing. The first of these provides the teacher with a systematic method of building a *test bank* of items (this function could also be included under the 'Teacher's Aide' category). At the simplest level, this would require only that the teacher have access to a computer, as the actual tests would be printed out, duplicated, and administered to students in the traditional pen-and-paper form. The computer would function as a structured word processor, allowing teachers to enter and edit sections of related test items over a period of time.

Once the item bank has been established, the computer can be asked to generate a 'new' test by randomly choosing ten questions from section one, five questions from section two, and so on, printing them out in correctly numbered form with the standard instructions included automatically. In this way, 'new' tests can be generated (together with answer keys if included in the program) with virtually no further teacher effort each time the course is given.

At a more ambitious level, the items in each section could be standardized so that the computer could generate and print out a different test for each student. The answers could then be entered into the computer, which would perform the necessary processing of raw scores to equalize the test results. While attractive on several counts, this sophisticated test generation approach would require far more time and expense in its development.

If sufficient computer systems are available, tests generated as above can also be administered to the student at the computer keyboard. This type of *direct administration* represents the second level of computer involvement in testing and offers numerous benefits. Naturally, all scoring and grading of the tests can be done instantly by the computer, the results being available for display on the video screen, storage on diskette, or printing out in report format. For research and development applications, much of the routine labor involved in item analysis, statistical computations, correlation studies, and test standardization would be eliminated. Diagnostic tests can also be directly tied into specially tailored courses of study, including CALL materials if desired.

The third level of computer involvement offers a still more attractive possibility: *computer-adaptive testing*. In a computer-adaptive test, the items are divided into sections covering a given language point as described above, but within each section several levels of difficulty are distinguished. For example, section five might deal with pronouns; items on *you* and *we* would be level one (beginning) in difficulty, whereas test items on *yourself* and *yourselves* might be considered level three (intermediate). The adaptive proficiency or placement test would continually adjust to each student's level as established in the test so far. Thus, students whose answers showed they were beginners would never receive items at the intermediate or advanced level. Instead, the computer would automatically present items pitched at each student's approximate perceived ability level until a consistent estimate of proficiency was established.

If one compares this procedure with a traditional paper test, where many of the items in a fixed set are either much too easy or much too difficult for the students, it is clear that adaptive tests are potentially more accurate and considerably shorter. They are also more humane in that fewer of the items will be beyond the students' competence, so that there will be less tendency to impress beginning and intermediate level students with their lack of knowledge.

ENGLISH FOR SPECIFIC PURPOSES

ESP classes in the United States are frequently composed of students with a mixed range of academic or technical interests. This situation can be handled to some extent by generalized 'academic' or 'vocational' materials, but students and their teachers often feel the need for at least some activities directly focused on students' own particular subject areas. Through its power to provide individualized learning, the computer represents a valuable resource in the ESP program (Wyatt 1982). One of the main problems is the time taken to produce parallel sets of learning materials in a number of different subject areas and contexts. In the short term, one solution may be the use of suitable authoring systems that will permit the teacher to rapidly enter simple yet worthwhile learning materials directly targeted toward the ESP interests of individual students in a particular class.

In terms of immediate applications, however, the best source of software for ESP courses may well be computer-based simulations. A large and growing range of simulation programs is to be found in a surprisingly wide spectrum of subject areas: economics, business, physics, chemistry, and aviation are just a few examples. An attractive course unit might be structured around a simulation that was never intended for language-teaching purposes. It might begin with the review of key concepts and vocabulary, move to student work with the simulation followed by discussion of the experience, and finish with a written assignment based on the results. Existing simulations can thus be exploited to provide highly motivating ESP modules.

Where computers are available, one possibility (entirely separate from CALL) is to use the computer itself as the object of authentic study activities. Using some of the extensive course material designed for native speakers, the ESP curriculum could include a brief computer literacy course. Even for nontechnical students, basic computer knowledge and literacy are fast becoming prerequisites for full participation in academic life. Humanities as well as science and technology students could benefit from activities based on computer technology to foster communicative language use through team projects and individual study.

Computers can also provide extremely valuable information to the ESP course developer through their ability to analyze passages of text in each ESP register. Textual analysis will be discussed in more detail in the 'Teacher's Aide' section.

BILINGUAL ESL

As with ESP, the applications of computer-assisted techniques in bilingual ESL are based directly upon the computer's capacity to individualize the presentation and practice of learning materials. In the case of BESL, however, it is not the context that is being individualized, but rather the language of instruction and the exercise materials.

At the beginning level of learning English, there are frequently instructions and explanations that could be greatly clarified for students if they could be presented in the students' native languages. In theory, computer-assisted techniques clearly hold the potential to implement this, whether in text form on the screen or through audio materials. The practical limitation is again the time necessary to produce parallel sets of material, although this is less of a problem than with ESP, because only the explanations and instructions need to be adapted. One example of course materials adapted for different BESL purposes is a curriculum that is available in two forms for speakers of Mandarin Chinese and Spanish (from the Computer Curriculum Corporation). A large integrated curriculum of this sort has not yet been produced for microcomputers, but an increasing number of individual programs for BESL are becoming available (Sauve and Schnuer 1983; Wyatt 1984). Of course, as students progress, the use of the native language is rapidly reduced, and it is soon replaced exclusively by the target language.

A further possibility is the modification and individualization of CALL activities, based on native language background. Through contrastive analysis and pedagogical experience, special areas of difficulty can be predicted for speakers of specific languages. In principle, computer-assisted materials, coupled with extra assistance such as contrastive explanations, could provide more extensive practice for these students.

The computer can provide valuable information to the BESL course developer who is involved in specific vocational areas. Through its ability to analyze the language of vocational textbooks or manuals typed into it, the computer can provide specific information on lexis and syntax. Textual analysis will be discussed at more length in the following section.

TEACHER'S AIDE

Many of the ways in which the computer can directly assist teachers have been outlined in previous sections. Once teachers have sampled the delights of *word processing*, with all materials available for continuous review, editing, and reuse, it is unlikely that they will use typewriters again except for brief notes. Even without the special programs described in the section on testing, it is a considerable convenience to be able to modify and recycle tests stored as documents. Word-processing documents can generally be used with *spelling check* programs that eliminate embarrassing and misleading errors on materials prepared for students. Stored passages can be automatically analyzed for *readability* in terms of several of the standard reading indices.

Linguistic research can also be performed through programs designed to generate *concordances* and similar types of textual analysis on word-processing documents (Macdonald et al. 1982). In one kind of concordance, every word that occurs in the reading passage is printed down the center of the page in alphabetical order. To the left of the word, the sentence context immediately preceding it is printed as far as space permits, and to the right the sentence context immediately following it. This permits important insights into aspects of vocabulary and grammar. If conditionals are of interest, for instance, many data are obtainable at a glance from the *if*, *unless*, and *whether* sections of the alphabetized concordance. Similarly, *frequency analysis* can be run on a document, producing anything from a simple alphabetic word list, with the number of occurrences printed after each lexical item, to a sophisticated analysis of the most common three-word combinations in the text.

This type of analysis can be of tremendous value to all course developers, but it is particularly helpful in ESP course design. Unfortunately, the memory and processing speed requirements have largely restricted any powerful textual analysis to large computer systems (Macdonald et al. 1982), although one microcomputer-based concordance generator has recently been reported (Davison 1983). However, there are several programs for microcomputers that will perform simple readability and word frequency computations.

Computers generally permit direct access to a source of research information that is growing rapidly in importance: the on-line database. With a microcomputer, an additional peripheral known as a modem is necessary to gain access to databases over standard telephone lines. One type of modem has a receptacle into which the telephone receiver is placed. Modems essentially transform outgoing information from the computer into a form suitable for transmission over telephone lines, and convert incoming information to a form that the computer can recognize. Using a modem, even some inexpensive microcomputers can be connected to a wide range of information sources. There are an increasing number of small, specialized electronic 'bulletin boards' in addition to the very large databases maintained by information systems such as ERIC (Educational Resources Information Center). Using the same type of equipment, it is also possible to communicate directly with colleagues via their computers and to send documents and programs as 'electronic mail.'

There are a number of programs that permit the teacher to produce interesting *supplementary materials* for use in the traditional classroom. With one such program, the teacher can produce crosswords for student use in a matter of seconds. Words of the teacher's choice are typed in one at a time, and the computer displays the embryonic crossword on the screen. If the first position suggested by the computer for a new word is not pleasing, other possible positions can be explored before settling on the final form. When all the words have been entered, the teacher is prompted for clues to each of the horizontal and vertical entries. Finally, the complete crossword with clues can be printed out in highly professional-looking form for duplication and distribution to students. If sufficient computers are available, there are variants of this program that permit students to work on the crossword directly at the computer. Similar types of programs are available to assist teachers in preparing other kinds of language game activities such as *anagrams* and *word searches*.

A final use of the computer is as an *electronic gradebook*. In many instructional CALL materials, a complete score reporting and management system is built in. However, it is possible to buy separate class management programs that enable the teacher to enter all the course grades, whether from CALL or traditional activities. These electronic gradebook programs eliminate the work involved in computing averages and generating class statistics, but they do require the additional effort of entering all grades manually at the keyboard. It may be that they represent a worthwhile saving of effort only with relatively large classes or lengthy lists of scores to be averaged.

Section C: Directions and Resources for Development in CALL

Chapter 10: Future Directions and Considerations

In a number of areas of education, computer-assisted learning has already begun to fulfill its promise. One very successful case history is in basic mathematics (Ragosta et al. 1982). Here, instructional materials of the drill-and-practice and tutorial type have consistently shown that they can significantly enhance regular classroom instruction.

For those interested in collaborative methodologies, the geometrical *microworlds* created on the computer screen with the aid of the Logo programming language (Papert 1980) are of great interest. Using Logo, even young children can play with and discover logical, geometrical, and mathematical principles for themselves, partly because the results of their efforts are shown in concrete graphical form. (To make this even more tangible for very young learners, teachers can start with an electronic robot 'turtle' that moves about on the classroom floor under computer control.) The evidence so far is generally only anecdotal, but 'working' or 'playing' within these microworlds does appear to offer entirely new educational experiences that are very attractive to learners.

Can these results be duplicated in the area of language learning? As far as instructional materials are concerned, investigation into the efficacy of language arts materials have consistently shown positive results (Ragosta et al. 1982), although the gains are sometimes relatively small. As far as ESL is concerned, student reaction to basic instructional materials has generally been very favorable, and students report that such courseware has beneficial effects on their learning (Merkel et al. 1980). Collaborative and facilitative uses of CALL are comparatively new, and informal evidence for their efficacy is all we have. As is generally the case, students and teachers both report their experiences in positive terms. Clearly, however, far more research is needed into the effectiveness and value of computer-assisted ESL.

In the area of courseware, one of the chief short-term problems is its relative scarcity. It was mentioned previously that some of the longer-established larger-computer systems have extensive ESL courseware packages. The microcomputer user is in a very different position, with relatively little available at present. As our principal suppliers of educational materials, the major publishing houses would seem the logical source to turn to, but they have been extremely cautious in moving into the new market. This situation is now beginning to change, and some momentum is developing in the design and production of ESL software.

The question of software quality is also of concern and has been greatly complicated by some fundamental misunderstandings and confusion. As we have seen, software may be broadly divided into instructional, collaborative, and facilitative categories, depending on the role of student and computer. All too often, software is characterized as being 'poor,' when in fact it achieves its goals rather well but does not fall into the category of CALL that the reviewer happens to favor.

Similar problems arise when courseware is criticized on grounds of style and special effects rather than basic educational value (Wyatt 1981). This is particularly true in the area of graphics. Recently, there has been widespread criticism of programs that are essentially text based with few graphics. One frequently heard point is that these programs do not take full advantage of the capabilities of the computer. On closer examination, this appears to be a completely irrelevant question--a programmer's criticism, rather than that of an educator. If a program is effective and educationally valid, it seems unnecessary to worry about which capabilities of the computer happen to be exploited.

Partly in reaction to the criticism, some recent CALL materials have begun to incorporate sophisticated high-resolution pictures. Unfortunately, in some of these programs, the graphics actually appear to obstruct the learning process by distracting attention and slowing the student down. Graphic material may have an important role to play in some programs, but their inclusion should be based on a valid educational rationale. They certainly need not be included merely to hold the learner's interest--experience shows that well-programmed 'text only' materials are extremely effective in attracting and keeping students' attention.

One of the most irksome problems in CALL is the inability to transport software easily from one computer model to another. Of course, where the second computer is intended to be a functional copy of the first, as with 'Apple-compatible' or 'IBM-compatible' computers, the question of transportability should not arise. These computers are specifically designed to run the software programmed for the Apple or IBM. Even in these cases, however, software compatibility is not always achieved.

With computers that are not intended to be 'compatibles,' the problem is much more serious. In the last few years, it has often been suggested that a solution is 'just around the corner.' The use of PILOT as a common programming language for courseware is one example of these proposals. Unfortunately, there are very compelling technical and marketing reasons for the difficulty in transferring software. Claims for methods of making programs transportable should be treated skeptically. On closer examination, they usually make the process easier, but considerable programming time and effort are still necessary to complete the transfer.

Some time ago, Bork pointed out that the ultimate solution may lie in the falling cost of microcomputer systems (Bork 1981). At this writing, the price of the least expensive computer on the U.S. market has fallen to $50, and it will doubtless be even lower when this book is published. If computers with sufficient power for educational applications fall to a comparable price level, as Bork points out, it will be cheaper for institutions to buy new microcomputers (in order to be able to run new software) than to pay for the software to be rewritten for their existing hardware.

One factor that offers both promises and pitfalls for CALL is the continuous arrival of newer, more advanced technology. The benefits of powerful, sophisticated computer systems and peripherals have been mentioned on numerous occasions throughout this book. Power and sophistication are no longer limited to mini- and mainframe computers. There are microcomputers specifically designed for educational purposes that cost fifteen to twenty times as much as many of the basic systems in use today. This type of hardware clearly has much to offer if an institution can afford it. The danger lies in the position adopted by some experts in computer-assisted learning to the effect that relatively powerful, expensive systems represent the minimum acceptable level of hardware.

If this attitude were to become widespread, we would be returning to the middle of the last decade, during which only a few well-funded institutions could afford the equipment for computer-assisted learning. Fortunately, uncomplicated computer hardware has already penetrated our schools and proven its worth to such an extent that pronouncements about expensive 'minimum systems' are unlikely to be heeded. As computer prices continue to fall steeply while their capabilities expand, we will all come to share in the benefits of more sophisticated hardware.

Before leaving the subject of advanced hardware, an exciting development in the use of interactive video hardware should be mentioned. As indicated previously, videodiscs under computer control will undoubtedly be used to enhance CALL materials. However, recent advances in large-screen television technology are opening up the way for the emergence of the television/videodisc combination as a striking new aid to traditional class teaching.

Integrated completely with the textbook materials, videodisc still frames or film sequences shown on the wide-screen television 'blackboard' could serve as the stimulus and focus for classroom language activities. Properly used, such video-assisted language teaching (VALT) has the potential to provide more realistic, authentic contexts for many of the activities that now take place in the classroom.

One area of serious concern in the past has been the lack of communication among CALL users at all levels. To alleviate this problem, umbrella organizations such as CONDUIT have been formed to promote the flow of information about software and hardware in a broad range of academic subject areas. However, the main problem today is for software developers and users to become aware of precisely what types of courseware are currently available or under development in their own subject area. Thus, the most urgent need is for *subject-specific* guides, textbooks, clearinghouses, and newsletters.

In ESL this essential function is now beginning to be better served. Books on the principles and programming of CALL (Davies and Higgins 1982; Higgins and Johns 1984; Kenning and Kenning 1984) and practical information on hardware and software for CALL (Hertz 1983a; Wyatt 1984) have appeared recently. Organizations such as the Center for Applied Linguistics (CAL), the National Clearinghouse for Bilingual Education (NCBE), the Computer-Assisted Language Instruction Consortium (CALICO), and the CALL Interest Section of TESOL will help to provide information on a continuing basis. With the encouraging progress in this and many other areas of concern, the future of computer-assisted learning in ESL seems bright indeed.

Sources of Software and Information on CALL

1. BIPACS 33 West Walnut Street, Long Beach, NY 11561
2. Borg-Warner 600 West University Drive, Arlington Heights, IL 60004
3. CALICO 233 SFLC, Brigham Young University, Provo, UT 84602
4. Callboard 19 High Street, Eccleshall, Stafford ST21 6BW, England
5. CEEDE College of Education, University of Iowa, 218 Lindquist Center, Iowa City, IA 52242
6. Center for Applied Linguistics/ERIC Clearinghouse on Languages and Linguistics 3520 Prospect Street, N.W., Washington, DC 20007
7. CHECpoint Systems 1520 North Waterman Avenue, San Bernardino, CA 92404
8. CILT 20 Carlton House Terrace, London SW1Y 5AP, England
9. COMPRESS P.O. Box 102, Wentworth, NH 03282
10. COMPUTER CURRICULUM CORPORATION 1070 Arastradero Road, Palo Alto, CA 94304

11. CONDUIT M310 Oakdale Hall, University of Iowa, P.O. Box C, Oakdale, IA 52319

12. DORMAC P.O. Box 1699, Beaverton, OR 97075

13. EIS Audio 804 North Neil Street, Champaign, IL 61820

14. Encyclopedia Britannica 425 North Michigan Avenue, Chicago, IL 60611

15. Gessler Publishing Company 900 Broadway, New York, NY 10003

16. Hartley Courseware Box 431, Dimondale, MI 48821

17. Heinle and Heinle 29 Lexington Road, Concord, MA 01742

18. Infocom 55 Wheeler Street, Cambridge, MA 02138

19. Instructional Development Systems/Skillcorp Software 3741 Old Conejo Road, Newbury Park, CA 91320

20. J-WARE 1316 Gibbs Avenue, St. Paul, MN 55108

21. Minnesota Educational Computing Consortium (MECC) 2520 Broadway Drive, St. Paul, MN 55113

22. Muse Software 347 North Charles Street, Baltimore, MD 21201

23. National Center for Bilingual Research (NCBR) 4665 Lampson Avenue, Los Alamitos, CA 90720

24. National Clearinghouse for Bilingual Education (NCBE) 1555 Wilson Boulevard, Rosslyn, VA 22209

25. Ontario Institute for Studies in Education
(OISE) 252 Bloor Street West, Toronto, Ontario
M5S 1V6, Canada

26. PLATO Control Data Corporation 3100 South
Avenue, Minneapolis, MN 55440

or PLATO Computer-based Education Research
Laboratory (CERL) University of Illinois,
Urbana, IL 61801

27. Regency Systems 1610 Interstate Drive,
Champaign, IL 61820

28 Regents/ALA 2 Park Avenue, New York, NY 10016

29. Scholastic, Inc. 902 Sylvan Avenue, Englewood
Cliffs, NJ 07632

30. School and Home Courseware 1341 Bulldog Lane,
Fresno, CA 93710

31. Scott Voice-Based Learning Systems 1111 Willow
Springs Drive, Denton, TX 76201

32. Specialized Curriculum Design 4614 Chase
Avenue, Bethesda, MD 20814

33. TESOL CALL Interest Section TESL Centre,
Concordia University 1455 de Maisonneuve
Boulevard West, Montreal H3G 1M8, Canada

34. The Soft Spot 800 East Arapaho, Suite 110,
Richardson, TX 75081

35. TICCIT Hazeltine Corporation 7680 Old Spring-
house Road, McLean, VA 22102

36. Visage Videodisc, Inc. 12 Michigan Drive,
Natick, MA 01760

37. Wible Language Institute P.O. Box 870, Allen-
town, PA 18105

38. WICAT Systems 1875 South State Street, Orem,
UT 84057

39. Wida Software 2 Nicholas Gardens, London
W5 5HY, England

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